PART

VII

Dentofacial Deformities

Patients with congenital or acquired abnormalities of facial bones and soft tissue generally require the assistance of many medical and dental specialists to achieve maximal rehabilitation. Patients with malocclusions and facial abnormalities resulting from an abnormal growth of facial bones usually require the services of general dentists, prosthodontists, periodontists, orthodontists, and oral and maxillofacial surgeons. The care of patients with cleft lips and palates involves all of the dental specialists as well as pediatricians, plastic surgeons, otolaryngologists, speech and hearing therapists, and psychologists. Chapters 25, 26, and 27 outline the treatments available for these patients, the sequence of treatment, and the need for participation of dental generalists and specialists.

.Surgical procedures designed to enhance facial and total body esthetics arc increasing in popularity. Patients of all ages are interested in procedures to improve abnormal or unesthetic facial features such as poorly proportioned noses, weak chins, and protruding ears. Aging patients are interested in procedures that provide a more youthful appearance to the face. Oral and maxillofacial surgeons perform facial cosmetic procedures and help coordinate other aspects of cosmetic dental treatment to provide the best possible esthetic improvement. Chapter 26 discusses these topics.

Facial trauma and pathologic anomalies often result in the loss of large portions of the jaws and associated structures. Reconstruction of missing portions of the jaws and associated facial hones and soft tissues usually necesitates comprehensive and often multiple surgical treatments to rehabilitate the patient adequately. Chapter 28 discusses the principles of maxillofacial reconstruction.

Correction of Dentofacial Deformities

25

CHAPTER

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CHAPTER OUTLINE

Epidemiologic surveys demonstrate that a large percentage of the United States' population has a significant malocclusion. Many of these cases are severe enough to affect facial proportions, and approximately 5% may be classified as handicapping.[1]

Approximately 10% of the population has a class II malocclusion, 1% of which require surgical advancement of the mandible to correct the skeletal deficiency. A small percentage of the population requires surgical correction of anteroposterior maxillary excess to treat their class II malocclusions most satisfactorily. Class III malocdusions occur in 2.5% of the population, with 40% of these cases being severe enough to require surgical correction to obtain the best occlusal and esthetic result. In many class Ill malocdusions, the deformities can be attributed to abnormal skeletal position of the mandible; however, nearly 50% may be at least partially caused by maxillary deficiency.

Historically treatment of dentofacial deformities has been aimed at correction of dental abnormalities, with little attention to the accompanying deformity of the facial skeleton. In the last 40 years, surgical techniques have been developed to allow positioning of the entire midface complex, mandible, or dentoalveolar segments to any desired position. The combining of surgical and orthodontic procedures for dentofacial deformities has become an integral part of the correction of malocclusions and facial abnormalities-

CAUSES OF DENTOFACIAL DEFORMITY

Malocclusion and associated abnormalities of the skeletal components of the face can be classified as either *acquired* or *developmental.* Acquired deformities result from trauma or other external influences that alter facial morphology. Developmental deformities result from abnormal growth of facial structures. Although it is not within the scope of this book to present a detailed discussion of facial growth, an understanding of basic principles as they relate to the development of dentofacial deformities is essential.

Enlow's *Handbook of Facial Growth*[2] should be reviewed fora more complete discussion of the principles of facial growth.

General Principles of Facial Growth

The development of proper facial form and function is a complex process affected by many factors. The primary sites of growth in the face and cranium are the free margins of the bony surfaces, sutures, synchondroses, and mandibular condyle. In the area of the craniofacial complex, areas exist that appear to have their own intrinsic growth potential, including the sphenooccipital and sphenoethmoidal synchondroses and the nasal septum. In addition, the majority of growth of the bones of the face occurs in response to adjacent soft tissue and the functional demands placed on the underlying bone. This theory, called the *functional matrix theory,* explains the dimensions of these growth patterns,'

The general direction of the growth of the face is downward and forward. Both the maxilla and the mandible appear to grow by differential apposition and resorption of bone, producing changes in these two directions. Enlow[4] describes this phenomenon as *area relocation,* with the maxillary-mandibular complex enlarging in the downward and forward direction as an "expanding V" (Fig. 25-1). The direction and amount of growth characterise an individual's growth pattern. Alterations in the pattern of growth or in the rate at which this growth occurs may result in abnormal skeletal morphology of the face and an accompanying malocclusion.

Genetic and Environmental Influence

Genetic influence certainly plays a role in dentofacial deformities. Patterns of inheritance, such as a familial tendency toward a prognathic or deficient mandible, are often seen in a patient with a dentofacial deformity. However, the multifactorial nature of facial development precludes the prediction of an inherited pattern of a particular facial abnormality

Environmental influences also play a role in the development of dentofacial deformities. As early as the prenatal stage, intrauterine molding of the developing fetal head may result in a severe mandibular deficiency. Abnormal function after birth also may result in altered facia' growth. Respiratory difficulty, mouth breathing, and abnormal tongue and lip postures can adversely influence facial growth. Back braces with cervical support place pressure on the chin that can produce severe occlusal changes and alterations in the form of facial bones. This is primarily the result of forced changes in the direction of growth during a time in which growth is continuing.

Trauma to the bones of the face can obviously result in severe abnormalities of both the facial skeleton and the occlusion. In addition to the abnormality that occurs as

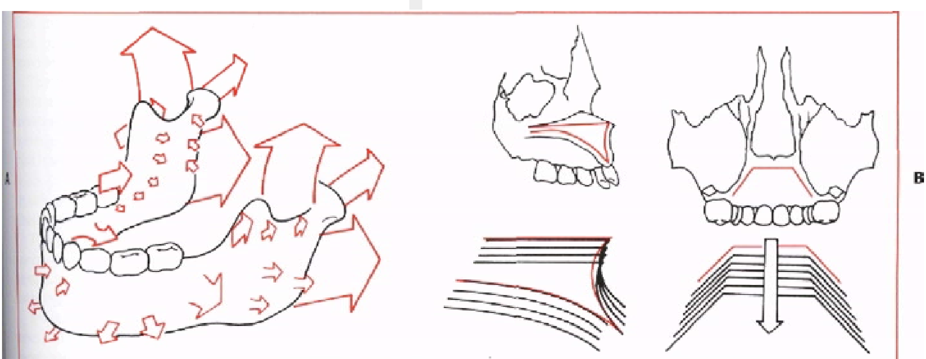

FIG. 25-1 A, Mandibular growth resulting from apposition and resorption of bone. Primary areas of bony apposition include superior surface of alveolar process and posterior and superior surfaces of mandibular ramus. B, Forward and downward growth of nasal complex and maxilla in "expanding V." Resorption of bone at superior surface of palate occurs simultaneously with apposition at inferior surfaces of palate and alveolar processes In addition, growth in posterior area of maxilla results in downward and forward expansion of maxilla, *(From Enlow DH:* Handbook of facial growth, *Philadelphia, 1975, WB Sounders.)*

A

B

FIG. 25-2 Ankylosis **resulting** from trauma to temporomandibular joint. Damage to condylar growth center Or limitation in function and the resulting soft tissue influence on developing bone tire responsible for resulting mandibular deficiency. A, Abnormal appearance of facial skeleton with severe mandibular deficiency. B, Severe class II malocclusion resulting from skeletal abnormality.

an immediate result of trauma, further effects on the development of facial bones may occur, which is most evident when ankylosis of the mandibular condyle occurs as a result of trauma. In the case of temporomandibular joint (TMJ) ankylosis in a growing child, alteration of growth may result from destruction of the area of growth in the TMJ cartilage, as well as from limitation in function, which decreases the influence of soft tissues on developing bone (Fig. 25-2).

EVALUATION OF PATIENTS WITH DENTOFACIAL DEFORMITY

In the past, individual practitioners often treated patient! with dentofacial deformities. Some patients have been treated with orthodontics alone, with a resultant acceptable occlusion but a compromise in facial esthetics. Oilier patients have had surgery without orthodontics in an attempt to correct a skeletal deformity, which resulted in improved facial esthetics but a less-than-ideal occlusion,

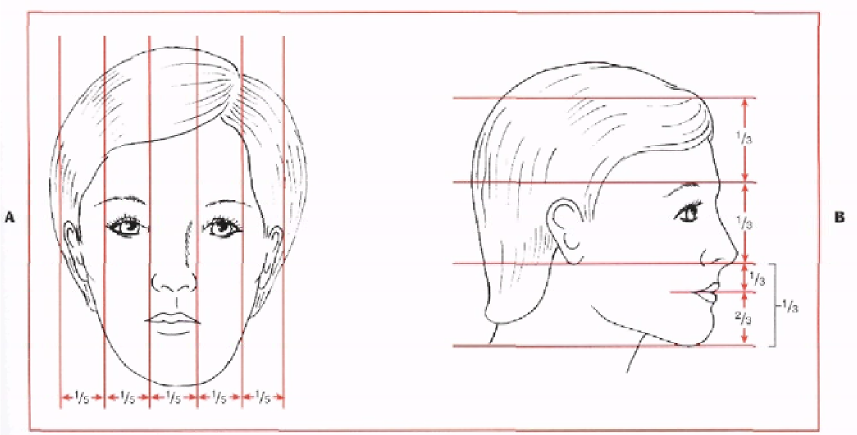

FIG. 25-3 Normal facia! proportions. A, Representation of proportional relationships of full-face view. Relationships of medial intercanthal distance, alar base width, and lip proportions to remainder of facial structures are demonstrated, B, Normal profile proportions demonstrates relationships of upper, middle, and lower thirds of face and proportional relationships of lip and chin morphology within lower third of face.

In addition to orthodontic and surgical needs, these patients often have many other problems requiring periodontic, endodontic, complex restorative, and prosthetic considerations.

Many areas of dental practice, in addition to orthodontics and surgery, must be integrated to address the complex problems of patients with dental deformities, ibis integrated approach, used throughout the evaluation, presurgical, and postsurgical phases of patient care, jrovides the best possible results for these patients.[s]

The most Important phase in patient care centers on evaluation of the existing problems and definition of rcatment goals. At the initial appointment a thorough nlcrvicvv should be conducted with the patient to discuss the patient's perception of the problems and the goals of any possible treatment. The patient's current health status and any medical or psychologic problems that may affect treatment are also discussed at this time.

The involved orthodontist and oial and maxillofacial surgeon should conduct a thorough examination of facial structure, with consideration of full-face and profile esthetics,

Evaluation of facial esthetics in the full-face view should assess the presence of asymmetries and evaluate overall facial balance. The evaluation should include assessment of the position of the forehead eyes, infraorbital rims, and malar eminences; configuration of the nose, including the width of the alar base; paranasal areas; lip morphology; relationship of the lips to incisors; and overall proportion*al* relationships of the face in the vertical and transverse dimensions. Fig. 25-3 demonstrates normal facial proportions. The profile evaluation allows an assessment of the anteroposterior and vertical relationships of all components of the face. The soft tissue configuration of the throat should also be evaluated. Photographic documentation of thepretreatment condition of the patient should be a standard part of the evaluation. Video and digital computerized images have recently been introduced as an additional aid in evaluating facial morphology.

A complete dental examination should include assessment of dental arch form, symmetry, tooth alignment, and occlusal abnormalities in the transverse, anteroposterior, and vertical dimensions. The muscles of mastication and TMJ function should also be evaluated. A screening periodontal examination, including probing, should assess the patient's hygiene and current pcriodontal health status. Impressions and a bite registration for dental cast construction and evaluation should also be obtained at this time.

Lateral eephalometric and panoramic radiographs (and posteroanterior facial films and TMJ films when indicated) aTe an important part of the initial assessment. The eephalometric radiograph can be evaluated by several techniques to aid in the determination of the nature of the skeletal abnormality (Fig, 25-4; Table 25-1).[6-7] It is important to note, however, that eephalometric radiographs are only a part of the evaluation process, Cephalometric evaluation should be combined with clinical assessment of the patient's facial structure and occlusion when the nature of the deformity is determined and possible treatment is planned. Computerized video and digital technology is currently available that helps to integrate the eephalometric data with digital images of the face to improve evaluation of the relationship of the

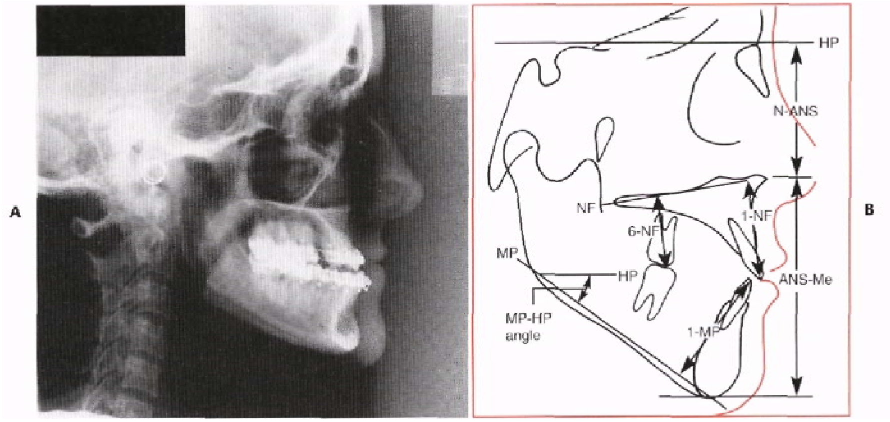

FIG. 25-4 A, Lateral cephalometric radiograph. B, Tracing of lateral cephalometric head film, with landmarks identified for evaluating facial, skeletal, and dental abnormalities, using system of cephalometrics for orthognathic surgery (see Table 25-1). *(B from Burstone cj et al: Cephaiometrics for orthognuthic surgery,* | Oral Surg *36-269, 1978.)*

TABLE 25-1

Orthognathic Cephalometric Analysis

	Standard (Male)	Standard (Female)
Horizontal (skeletal)		
N-A-Pg (angle)	3.9 degrees	2.6 degrees
N-A (II HP)	0.0 degrees	−2.0 degrees
N-B (II HP)	−5.3 degrees	−6.9 degrees
N-Pg (II HP)	−4.3 degrees	−6.5 degrees
Vertical (skeletal, dental)		
N-ANS (HP)	54.7 mm	50.0 mm
ANS-Gn (HP)	68.6 mm	61.3 mm
PNS-N (HP)	53.9 mm	50.6 mm
MP-HP (angle)	23.0 degrees	24.2 degrees
1-NF (NF)	30.5 mm	27.5 mm
1-MP (MP)	45.0 mm	40.8 mm
6-NF (NF)	26.2 mm	23.0 mm
6-MP (MP)	35.8 mm	32.1 mm
Maxilla, mandible		
PNS-ANS (II HP)	57.7 mm	52.6 mm
Ar-GO (linear)	52.0 mm	46.8 mm
Go-Pg (linear)	83.7 mm	74.3 mm
Ar-Go-Gn (angle)	119.1 degrees	122.0 degrees
Dental		
OP upper-Hp (angle)	6.2 degrees	7.1 degrees
OP lower-Hp (angle)	—	—
A-B (II OP)	−1.1 mm	−0.4 mm
1-NF (angle)	111.0 degrees	112.5 degrees
1-MP (angle)	95.9 degrees	95.9 degrees

Modified from Burstone C] e?L al: Cephalomelrics for orthognalhic surgery, *} Oral Surg* 36:269, 1 978.

underlying facial skeleton and overlying soft tissue. After careful clinical assessment and evaluation of the diagnostic records, a problem list and treatment plan should be developed. These combine opinions from all practitioners participating in the patient's caie, including the orthodontist, oral and maxillofacial surgeon, periodontist, and restorative dentist.

PRESURGICAL TREATMENT PHASE

Periodontal Considerations

As the first step in treatment, gingival inflammation must be controlled and the patient's cooperation ensured. In patients who arc unwilLing or unable to clean their teeth properly before the placement of orthodontic appliances, oral hygiene procedures will be even less effective when complicated by orthodontic band placement.

Periodontal therapy includes oral hygiene instruction scaling, and root planing; in certain instances, flap surgery to gain access for root planing may be necessary to provide proper tissue health. Whenever possible it is desirable to delay comprehensive treatment until adequate patient compliance and control of inflammation arc achieved.

As a result of the periodontal examination findings and proposed orthodontic and surgical plan, mucogingival surgery is often accomplished during this initial phase of therapy to provide a zone of attached keratinized tissue that is more resistant to potential orthodontic and surgical trauma. Soft tissue grafting is indicated in areas that have no keratinized gingiva or where only a thin band of keratinized tissue with little or no attachment is found when an increase in tissue trauma is likely (Fig. 25-5). Such trauma to these areas includes labial ortho

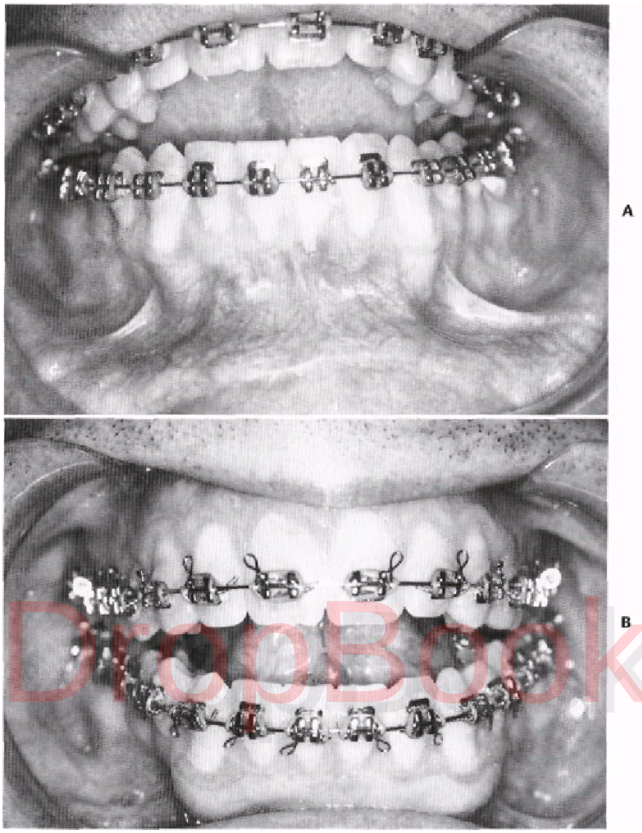

FIG. 25-5 A, Presurgical appearance of yingival tissue ljbidl to lower anterior teeth. Inadequate area of attachment antJ kertiLinization *h* visualized. B, Siynificant impfovement in attachment and keratini/ation of labial gingival tissue after ginrjival grafting.

dontic movement of teeth or a surgical procedure such as an inferior border osteotomy or segmental osteotomies in interdental areas.

Restorative Considerations

During the presurgical restorative phase, the patient is evaluated for carious lesions and faulty restorations. Teeth should be evaluated endodontically and periodontally for restorability, and any nonrestorable teeth should he extracted before surgical intervention. All carious lesions must be restored early in the presurgical treatment phase. Existing restorations must function for 18 to 24 months during the orthodontic and surgical treatment phases, requiring that more durable restorative materials (i.e., amalgam, composite resin) are used, even though they may be replaced during the definitive postsurgical treatment phase. It is wise to defay final restorative treatment until the proper skeletal relationships are achieved and the finishing orthodontics completed.

In the edentulous or partially edentulous patient, particular attention is paid to residual ridge shape and contour in denture-bearing areas. The distance between the maxillary tuberosity, posterior mandible, and ramus areas must be evaluated to ensure that adequate space is present for partial or complete dentures. Teeth that serve as removable partial denture abutments should be evaluated for potential retentive undercuts. If minor orthodontic movement can enhance undercuts, this Information is conveved to the orthodontist.

Presurgical Orthodontic Considerations

It is obvious that not all malocclusions require correction with surgery. When the skeletal discrepancy is minimal and orthodontic compensation does not adversely affect dental or facial esthetics or posttreatment stability, orthodontic treatment alone may be the treatment of choice. However, in some cases an adequate occlusal relationship cannot be achieved because of the skeletal discrepancy; some cases may be treated with orthodontic compensation for a skeletal abnormality, resulting in an adequate occlusion but poor facial or dental esthetics or a poor long-term prognosis for posttreatment retention. These cases should be considered for surgery combined with orthodontic treatment.

Treatment timing. Treatment of the stable adult deformity can be started without delay, but questions often arise about how to best manage the growing child who is identified as having a developing dentofacial deformity. If the facial pattern is favorable and adequate growth potential remains, growth modification with functional appliances may be the preferred approach to dentofacial problems. Surgery usually is reserved for patients who do not respond to growth modification. As a general guideline, orthognathic surgery should be delayed until growth is complete in patients who have problems of excess growth, although surgery can be considered earlier for patients with growth deficiencies.

Orthodontic treatment objectives. Undesirable angulation of the anterior teeth occurs as a compensatory response to a developing dentofacial deformity, Patients with maxillary deficiency, mandibular excess, or both often have, flared uppeT incisors and retroclined lower incisors (Fig. 25-6, *A* to C). Dental compensations for the skeletal deformity are corrected before surgery by orthodontically repositioning teeth propeTly over the underlying skeletal component, without considerations for the bite relationship to the opposing arch. This presurgical orthodontic movement accentuates the patient's deformity but is necessary if normal occhisal relationships are to be achieved when the skeletal components are properly positioned at surgery (Fig, 25-6, *D* to *F).* The surgical treatment then results in an ideal position of the skeletal and dental components (Fig. 25-6, *G* to j). The opposite dental compensation may occur in maxillary protrusion or mandibular deficiency (Fig. 25-6, j to L). Again, the decompensation is aimed at improving angulation of teeth over underlying bone, after which skeletal problems are corrected.

The essential steps in orthodontic preparation are to align the arches individually, achieve compatibility of the arches or arch segments, and establish the proper anteroposterior and vertical position of the incisors. The amount of presurgical orthodontics can vary, ranging from only appliance placement in a few patients to approximately 12 months of appliance therapy in those with severe crowding and incisor malposition.

As the patient is approaching the end of orthodontic preparation for surgery, it is helpful to take impressions and examine the Viand-articulated models for occiusai compatibility. Minor interferences that exist can be corrected easily with arch wire adjustment and significantly enhance the postsurgical occiusai result. After any final orthodontic adjustments have been made, large stabilizing arch wires are inserted into the brackets, which provide the strength necessary to withstand the forces resulting from intermaxillary fixation (IMF) and surgical manipulation,

Final Treatment Planning

After the completion of the presurgical periodonticSj restorative dentistry, and orthodontics, the patient returns to the oral and maxillofacial surgeon for final presurgical planning. The evaluation completed at the initial patient examination is repeated. The patient's facial structure and the malocclusion are reexamined,

PTesurgical photographs, radiographs, and presurgical models are taken, a centric relation bite registration and face-bow recording for model mounting are completed, and computer images are obtained when available.

Model surgery on a duplicated set of presurgical dental casts determines the exact surgical movements necessary to accomplish the desired postoperative occlusion (Fig. 25-7). Prediction tracings of the anticipated suTgical movements provide a visual treatment objective of the desired skeletal movements and resulting postoperative soft tissue changes from the lateral perspective (Fig. 25-8).

One of the most recent adjuncts to treatment planning for patients with dentofacial deformity is computerized imaging. This technology allows computerized digital images of the patient's face to be superimposed over bony landmarks obtained from the cephalometric radiograph. Cephaiometric treatment planning can be completed with computer assistance. The computer can then produce a digital image that represents the facial esthetic result produced by the associated facial skeletal change (Fig. 25-9 on page 570).

The advantage of using this type of technology is the ability to predict more accurately the facial changes that may result from a particular surgical correction. The facial images are also more easily evaluated by patients, allowing them to assess the predicted results and provide- input into the surgical treatment plan. The disadvantage of the technology is related to the computer's inability to accurately predict every type of surgical change for every patient. Different muscle tone and skin thickness and variable soft tissue response to bone change, for example, make it impossible for the computer to precisely predict each individual variation. However, with continued development, this technology will most litely become more common in the treatment planning and presurgical education for patients with dentofacial deformity.

After completion of the model surgery, prediction tracings, and computer imaging evaluation, the orthodontist or general dentist is often consulted to ensure that the predicted occiusai result is acceptable to all practitioners involved in the patient's treatment. Any orthodontic or restorative changes necessary to improve postsurgical position should be planned at this time.

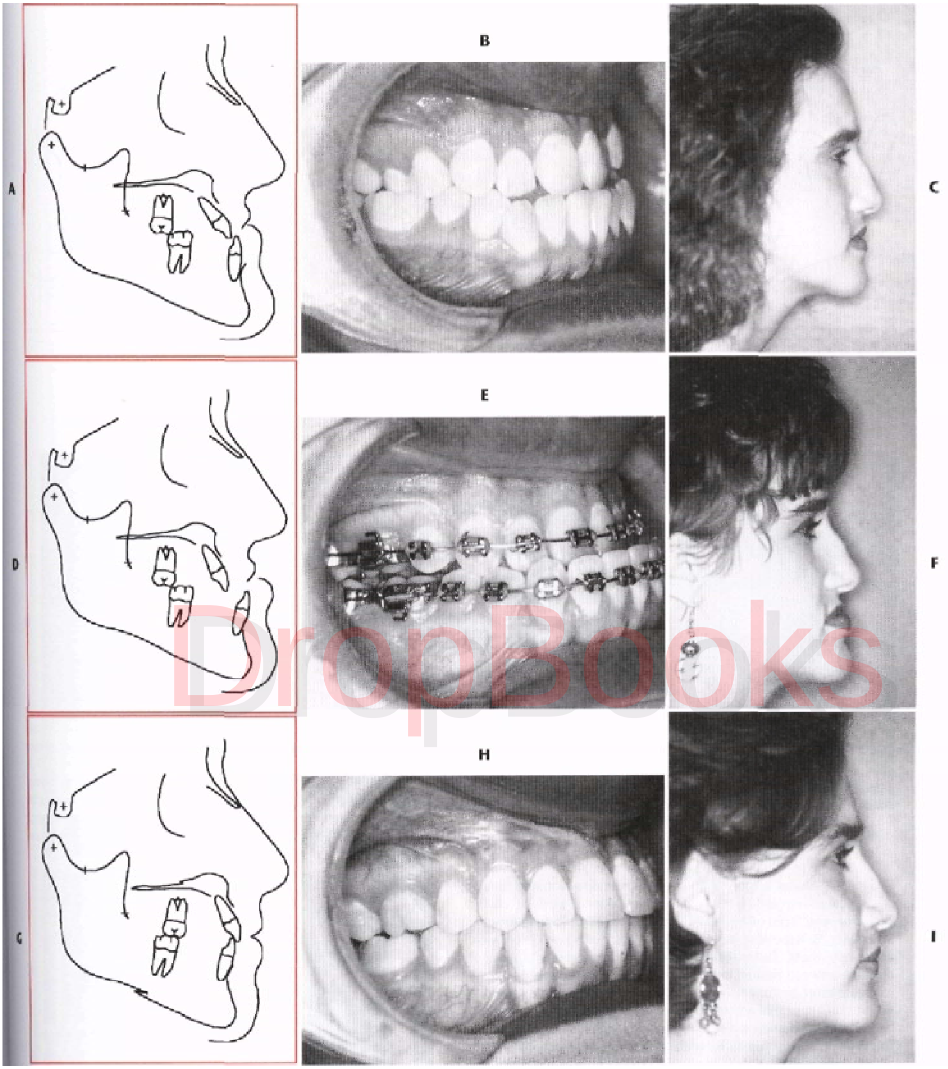

FIG. 25-6 A, Class lit skeletal malocclusion with maxillary deficiency and mandibi larexcess, B, Dental compensation includes retroclined lower inciiors and prodined upper incisor i. C, Facial profile. D, After initial orthodont c treatment before surgery. E, Dental compensation is re noved with proclination of lower incisors and retroclination of upper incisors, which obviously increases the severity of malocclusion and facial discrepancy. F, Facial profile. C, Surgical correction with posterior positioning of mandible and advancement of maxilla. H, Ideal occlusion. I, Facial profile.

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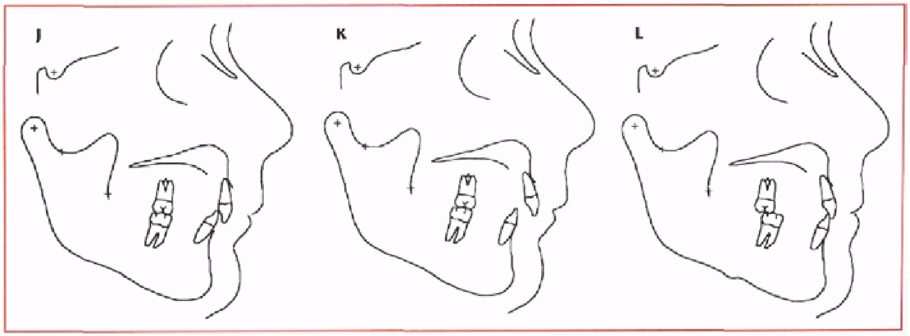
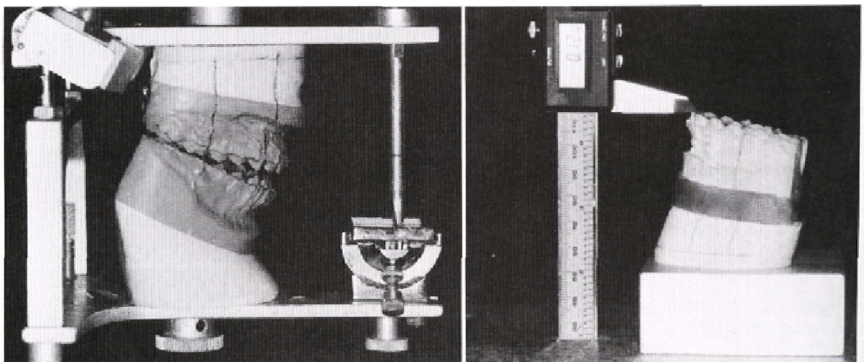
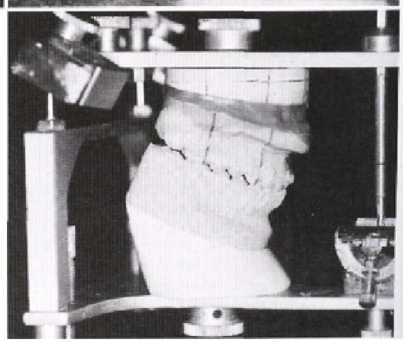


FIG, 25-6—cont'd J, Class II occlusion with compensation demonstrating proclination of lower incisors and upright upper incisors. K, After orthodontic decompensation. L, After surgical correction with mandfbular advancement.

A

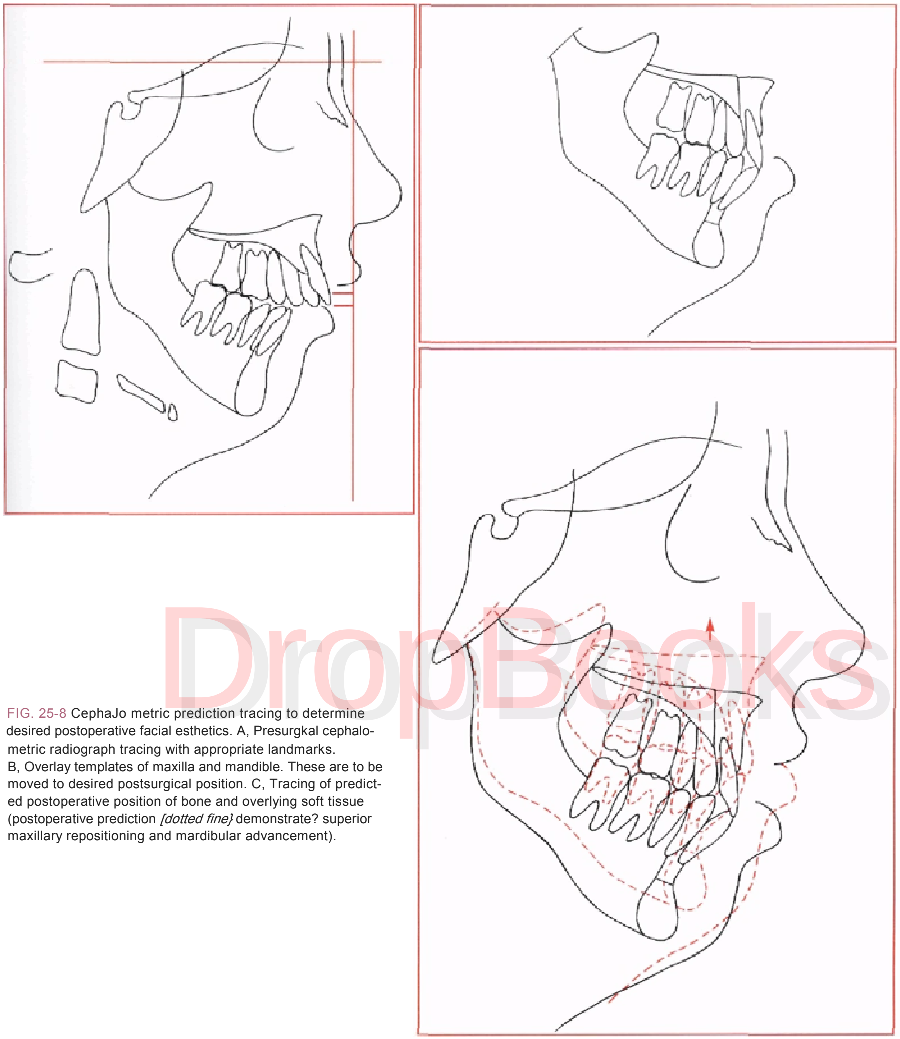


B



C

FIG. 25-7 Model surgery used to determine direction and distance of surgical movement necessary to achieve desired postoperative occlusion and facial esthetics. A, Casts mounted on semiadju^table articulator. B, Repositioning of maxillary casts using precision measuring instrument. Distances of mode) surgical movements are coordinated between desired facial esthetics and movements necessary to create ideal postoperative occlusion. C, Maxillary casts remounted on semiadjustable articulator after precision movements have been completed and verified. Intraoccljsal wafer is constructed on this final ocdusal setup to be used at time of surgery to align osteotomies and dental segments into desired postsurgical position.



B

C

FIG. 25-8 CephaJo metric prediction tracing to determine desired postoperative facial esthetics. A, Presurgkal cephalometric radiograph tracing with appropriate landmarks. B, Overlay templates of maxilla and mandible. These are to be moved to desired postsurgical position. C, Tracing of predicted postoperative position of bone and overlying soft tissue (postoperative prediction *[dotted fine}* demonstrate? superior maxillary repositioning and mardibular advancement).

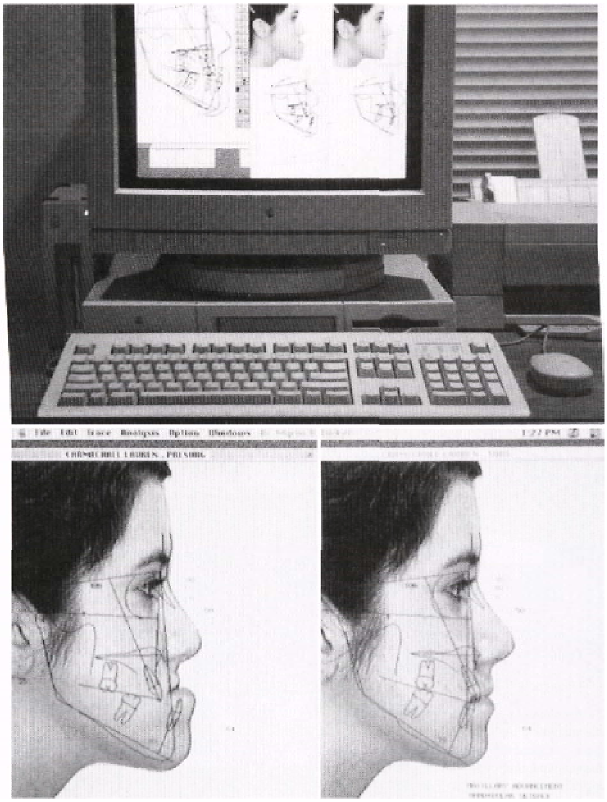
A B


FIG. 25-9 Computerized imaging for dentofacial surgical treatment planning. Digital image is obtained and placed in computer's memory. Landmarks from cephalometric tracing are superimposed over digital image of face. Portions of cephalometric radiograph can be moved in a manner similar to that used for prediction tracing as shown in Fig. 25-8. The computer then manipulates the image to depict soft tissue changes. A, Digital images displayed on the computer monitor shows predicted facial changes.* B, Close-up view shows presurgical and predicted final images that would result from anticipated surgical procedure (in this case, maxillary advancement and mandibular setback). (Text related to these images is found or page 566.)

*Quick Ceph Image System.

SURGICAL TREATMENT PHASE

Dentofacial abnormalities can frequently be treated by isolated procedures in the mandible or maxilla and midface area. Because abnormalities can obviously occur in both the maxiiia and the mandible, surgical correction frequently Tequires a combination of surgical procedures. The following sections describe a variety of surgical procedures completed either as isolated osteotomies or as combination procedures.

Mandibular Excess

Excess growth of the mandible frequently results in an abnormal occlusion with class III molar and cuspid relationships and a reverse overjet in the incisor area. An obvious facial deformity may also be evident. Facial features associated with mandibular excess include a prominence of the lower third of the face, particularly in the area of the lower lip and chin in the anteroposterior and vertical dimensions. In severe cases the large reverse overjet *may*

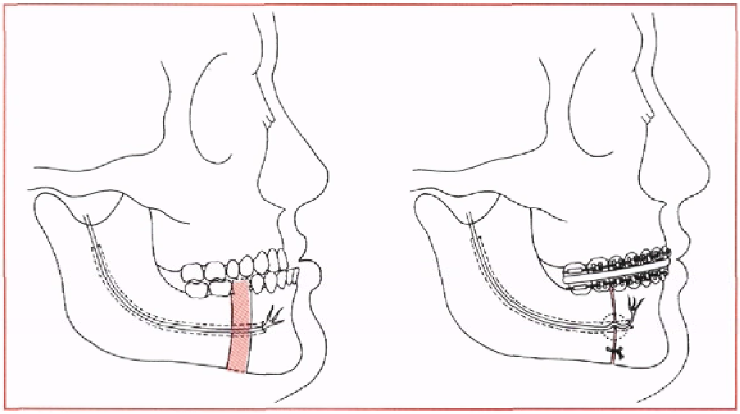


FIG. 25-10 Body ostectomy with resection of portion of body of mandible followed by posterior repositioning of anterior segment. A, Preoperative view. B, Postoperative view.

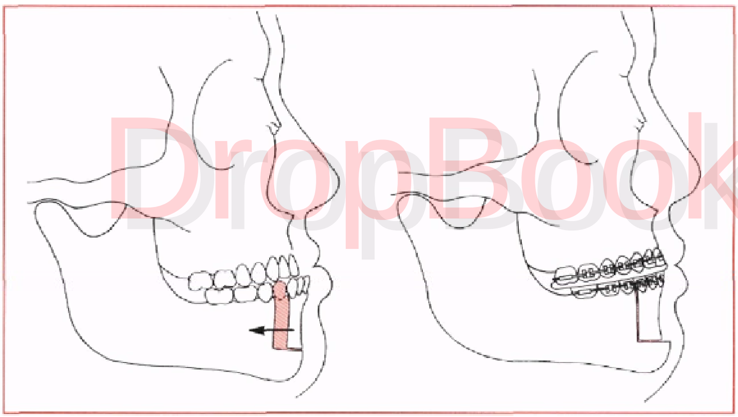


FIG. 25-11 Anterior mandibular subapical osteotomy. A, Removal of premolar teeth and bone in area of extraction sites. B, After separation, anterior dentoalveolar segment is repositioned posteriorly, extraction sites are closed, and anterior reverse overjet relationship is corrected.

produde the patient's ability to obtain adequate lip closure without abnormal strain of the orbicularis otis muscles.

Mandibular excess was one of the first dentofacial deformities recognized as being best treated by a combination of orthodontics and surgery. Although surgical techniques for correction ol mandibular excess were reported as early as the late 1800s, widespread use of currently acceptable techniques began in the middle of this century. Larly techniques for treatment of mandibular prognathism dealt with the deformity by removing sections of bone in the body of the mandible, which allowed the anterior segment to be moved posteriorly (Fig. 25-10). When the reverse overfet relationship is isolated to the anterior dentoalveolar area of the mandible, a subapical osteotomy technique can be used for correction of mandibular dental prognathism.[8] In this technique, bone is removed in the area of an extraction site of a bicuspid or molar tooth, and the anterior dentoalveolar segment of the mandible *h* moved to a more posterior position {Fig. 25-11).

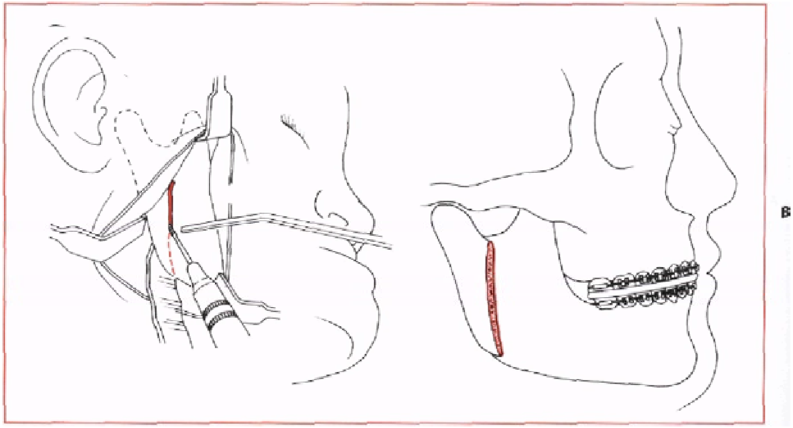


FIG. 25-12 Extraoral approach for vertical ramus osteotomy. A, Submandibular approach to lateral aspect of ramus showing vertical osteotomy from sigmoid notch area to angle of mandible. B, Overlapping of segments after posterior repositioning of anterior portion of mandible. Proximal segment containing condyle is overlapped On lateral aipect of anterior portion of ramus.

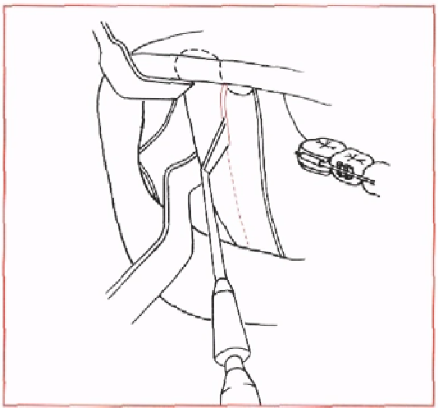


FIG. 25-13 Intraoral technique lor vertical ramus ostetomy through use *at* angulated oscillating saw.

In the early 1950s, Caldwell and Letterman' popularised an osteotomy performed in the ramus of the mandible for the correction of mandibular excess. In this technique the lateral aspect of the ramus is exposed through a submandibular incision, the ramus is sectioned in a vertical fashion, and the entire body and anterior ramus section of the mandible are moved posteriorly, which places the teeth in proper occlusion (Fig. 25-12).

The proximal segment nf the ramus (i.e., the portion attached to the condyle) overlaps the anterior segment, and the jaw is stabilized during the healing phase with wiring of the bone segments combined with faw immobili7ation using IMF. A similar technique is currently performed with an intraoral incision and an angulated oscillating saw (Fig. 25-13).[10] The design of the osteotomy is identical to that performed through an extraoral incision. The bone segments can be stabilized using IMF, with or without direct wiring of the segments or uiing rigid fixation with bone plates or screws, eliminating the need for IMF. The advantages of the intraoral technique include elimination of the need for skin incision and decreased risk of damage to the mandibular branch of the facial nerve. Fig. 25-14 demonstrates the clinical results of a patient treated with an intraoral vertical ramus osteotomy to correct mandibular excess.

Another popular technique for correction of mandibular prognathism is the bilateral sagittal split osteotomy (BSSO) first described by Trauner and Obwegeser[11] and later modified by Dalpont,[12] Hunslck,[13] and Epkei.[H]The BSSO is accomplished through a transoral incision similar to that for the intraoral vertical ramus osteotomy. The osteotomy splits the ramus and posterior body of the mandible in a sagittal fashion which allows either setback or advancement of the mandible (Fig. 25-15). The telescoping effect in the area of the osteotomy produces large areas of bony overlap that have the flexibility necessary to move the mandible in several directions. The 13SSO technique has become one of the most popular methods for treatment of both mandibular deficiency and mandibular excess. Disadvantages include potential Era Lima of the inferior alveolar nerve, with subsequent

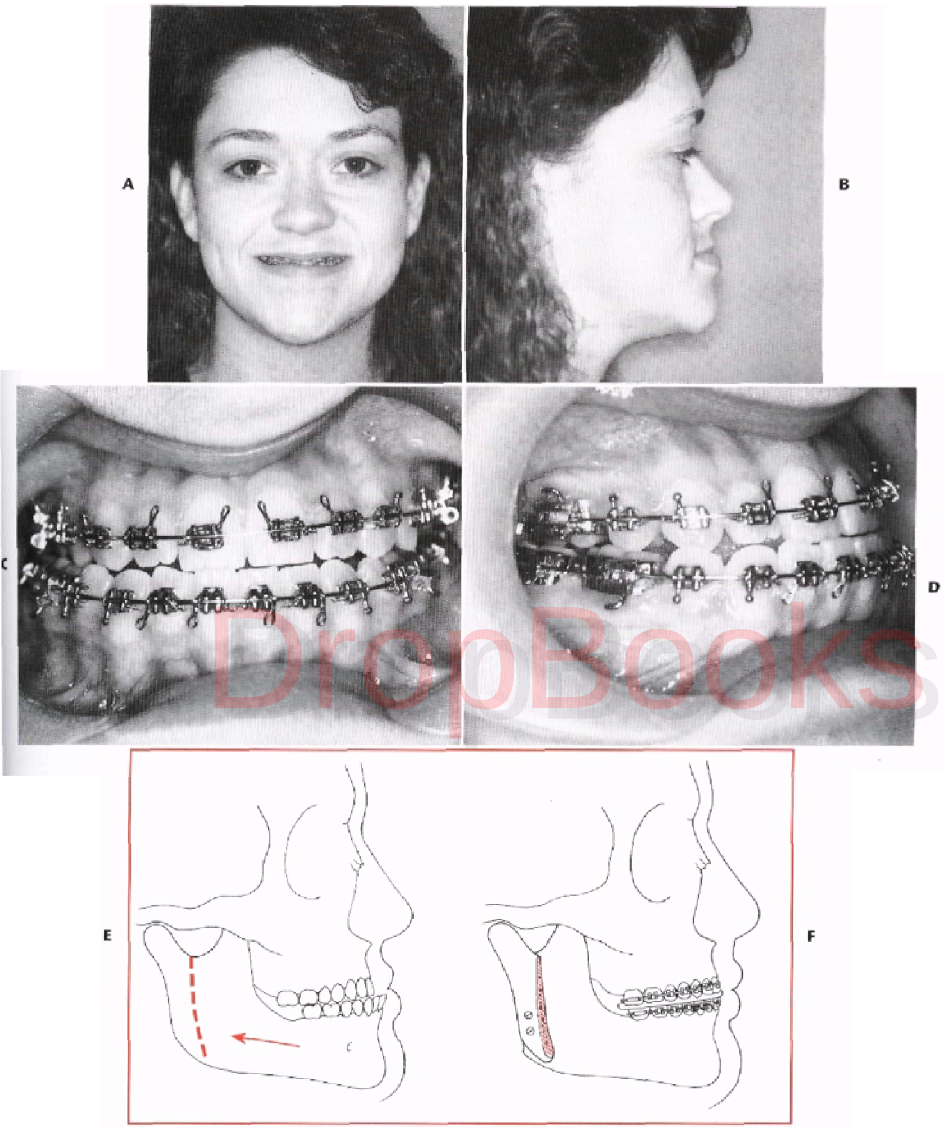


FIG. 25-14 Case report of mandibular excess A and B, Preoperative facial esthetics demonstrates typical features ol Class III malocclusion resulting from mandibular excess C and D, Presurgical ocdusal photos. E and F, Diagram of inlraoral vertical rarnui osteotomy with posterior positioning of maindFbfe.

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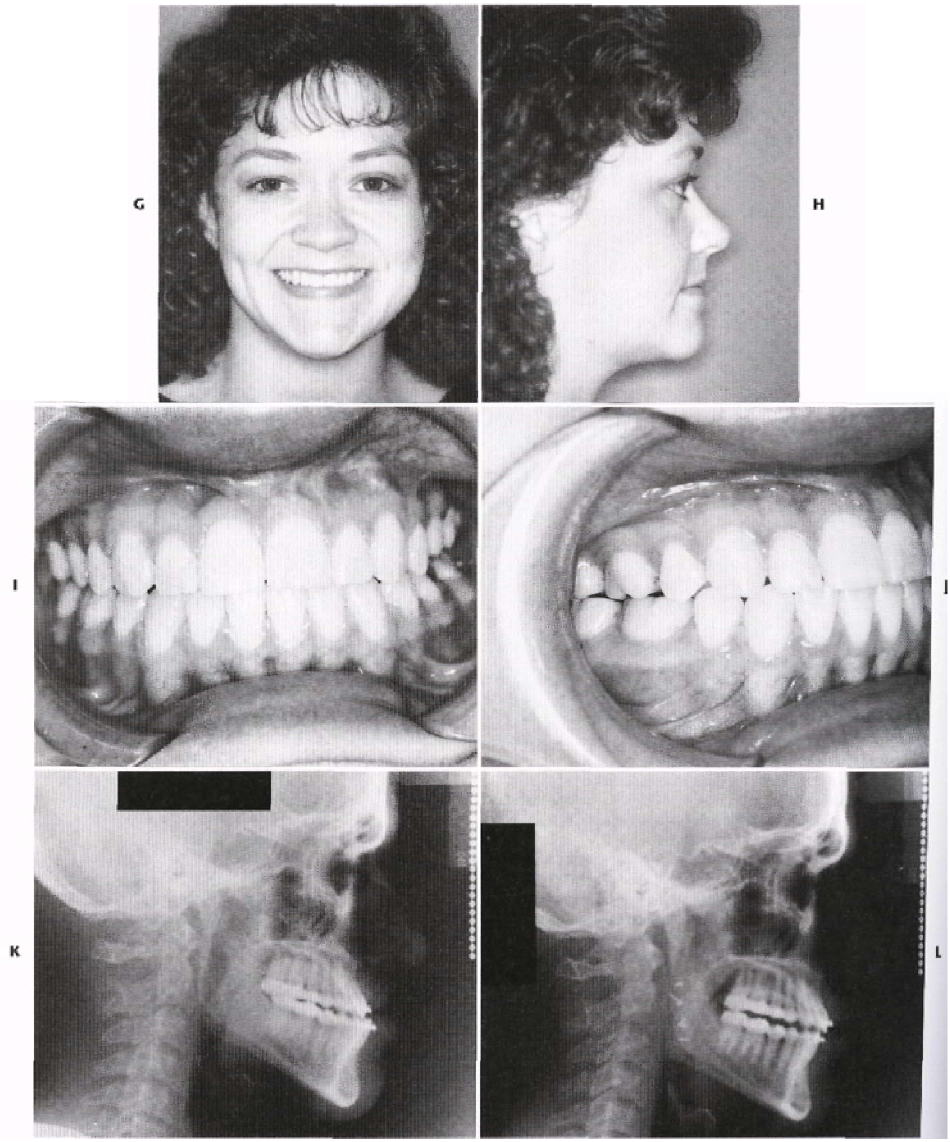

FIG. 25-14—cont'd G and H, Postoperative facial appearance. I and J, Postoperative occlusion. K and L, Preoperative and postoperative radiographs.

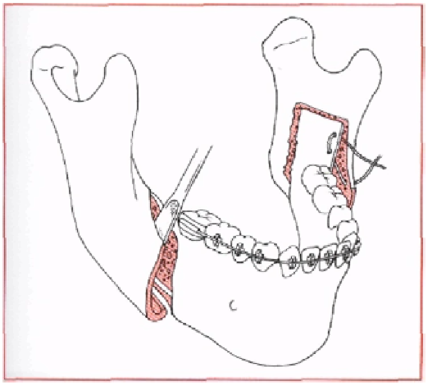

FIG. 25-15 Sagittal split osteotomy. Ramus of mandible is divided by creation of horizontal osteotomy on medial aspect and vertical osteotomy on lateral aspect of mandible. These are connected by anterior ramus osteotomy. Lateral cortex of mandible is then separated from medial aspect, and mandible can be advanced or set back for correction of mandibular deficiency or prognathism, respectively.

decreased sensation in the area of the lower lip and chin during the immediate postoperative period.

Mandibular Deficiency

The most obvious clinical feature of mandibular deficient iv is the retruded position of the chin as viewed from the profile aspect. Other facial features often associated with mandibular deficiency may Include an excess labiomental fold with a procumbent appearance of the lower lip, abnormal posture of the upper lip, and poor throat form, Intraorally, mandibular deficiency is associated with class II molar and cuspid relationships and an increased overjet in the incisor area.

Surgical correction of mandibular deficiency was described as early as 1909, However, early results with surgical advancement of the mandible before the 1950s were extremely disappointing, in 1957 Robinson[15] described surgical correction of mandibular deficiency using a vertical osteotomy and iliac crest bone grafts in the area of the osteotomy defect (fig. 25-16, *A).* Several modifications of this technique were made over subsequent years, including the development of the C osteotomy combined with sagittal splitting of the inferior border portion of the mandible (Fig. 25-16, *B).* These techniques, which require an extraoral incision, provide increased bony overlap, improve healing, and give better postoperative stability for mandibular advancement. However, the extraoral incisions had the disadvantages of scar formation and potential damage to branches of the facial nerve.

Currently the B.SSO$_f$ described earlier In this chapter, is the most popular technique for mandibular advance men I

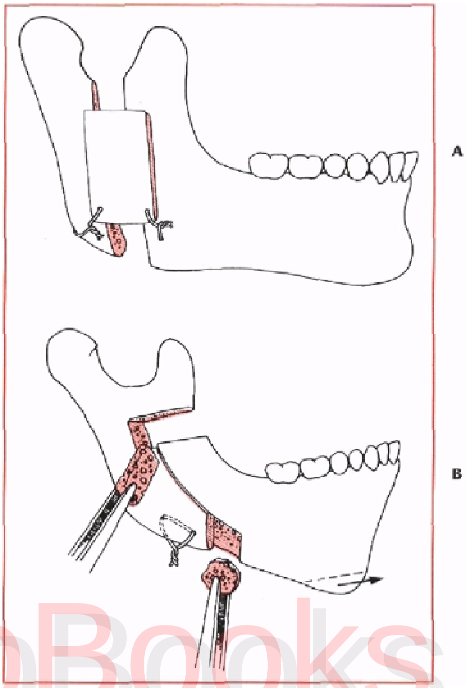

FIG. 25-16 Mandibular advancement techniques. A, Mandibular advancement using vertical osteotomy and iliac crest bone grafts in osteotomy defect B, Modified C osteotomy with sagittal splitting of inferior border of mandible combined with iliac crest bone grafts.

(Fig. 25-17). This procedure is easily accomplished through an intraoral incision, The significant bony overlap produced with the BSSO allows for adequate bone healing and improved postoperative stability. The osteotomy is frequently stabilized with rigid fixation plates or screivs, eliminating the need for IMF.

If the anteroposterior position of the chin is adequate but a class II malocclusion exists, a total subapical osteotomy may be the technique of choice for mandibular advancement (Fig. 25-18). By combining the osteotomy with interpositioned bone grafts, this technique can he used to increase lower facial height.

When a propeT occlusal relationship exists or when anterior positioning of the mandible would not be sufficient to produce adequate projection of the chin, an inferior border osteotomy (i.e., genioplasty) with advancement may also be performed. This technique is usually performed through an intraoral incision. The inferior

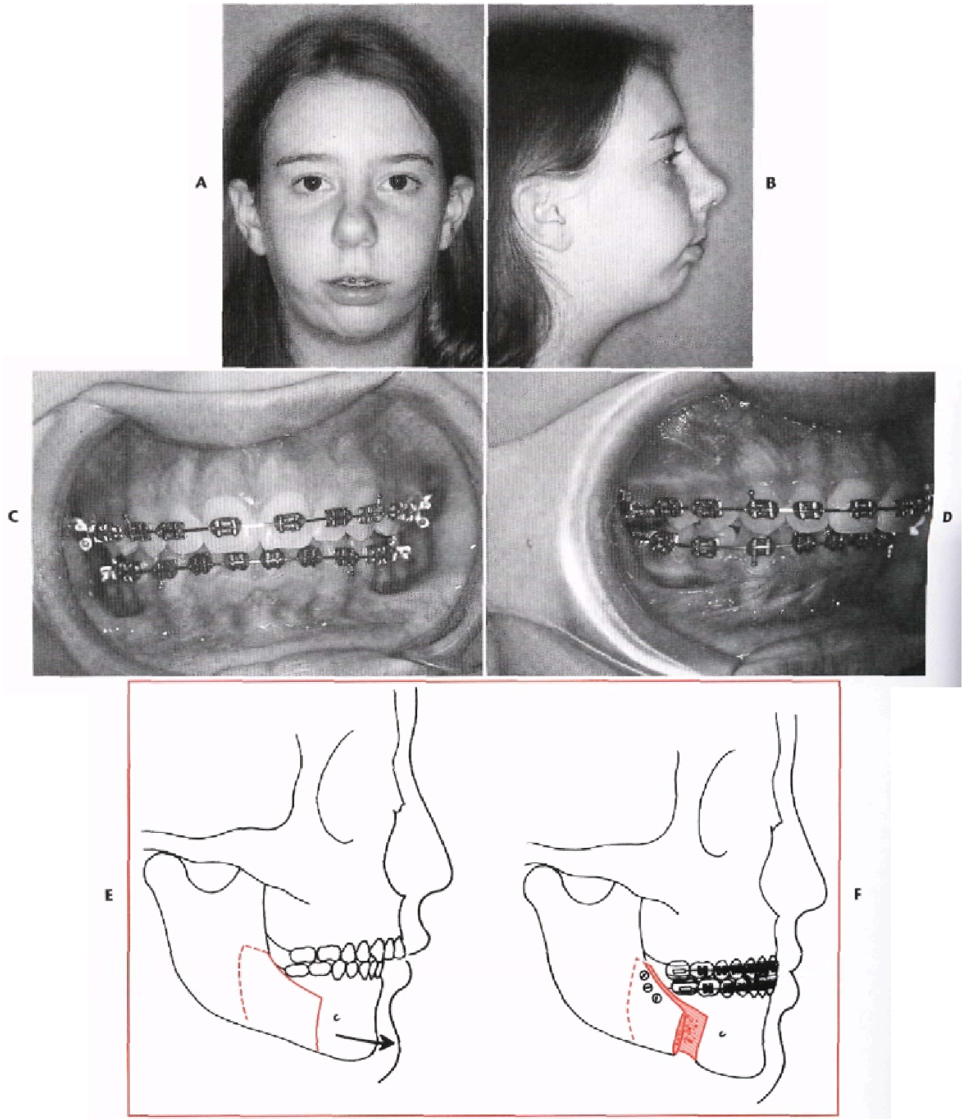

FIG. 25-17 Case report of mandibular advancement. A and B, Preoperative facial esthetics demonstrating clinical features of mandi'bular deficiency. C and D, Preoperative occlusion demonstrating class II relationship and overjet. E and F, Diagrammatic representation of bilateral sagittal split osteotomy (B55O) with advancement of mandible-

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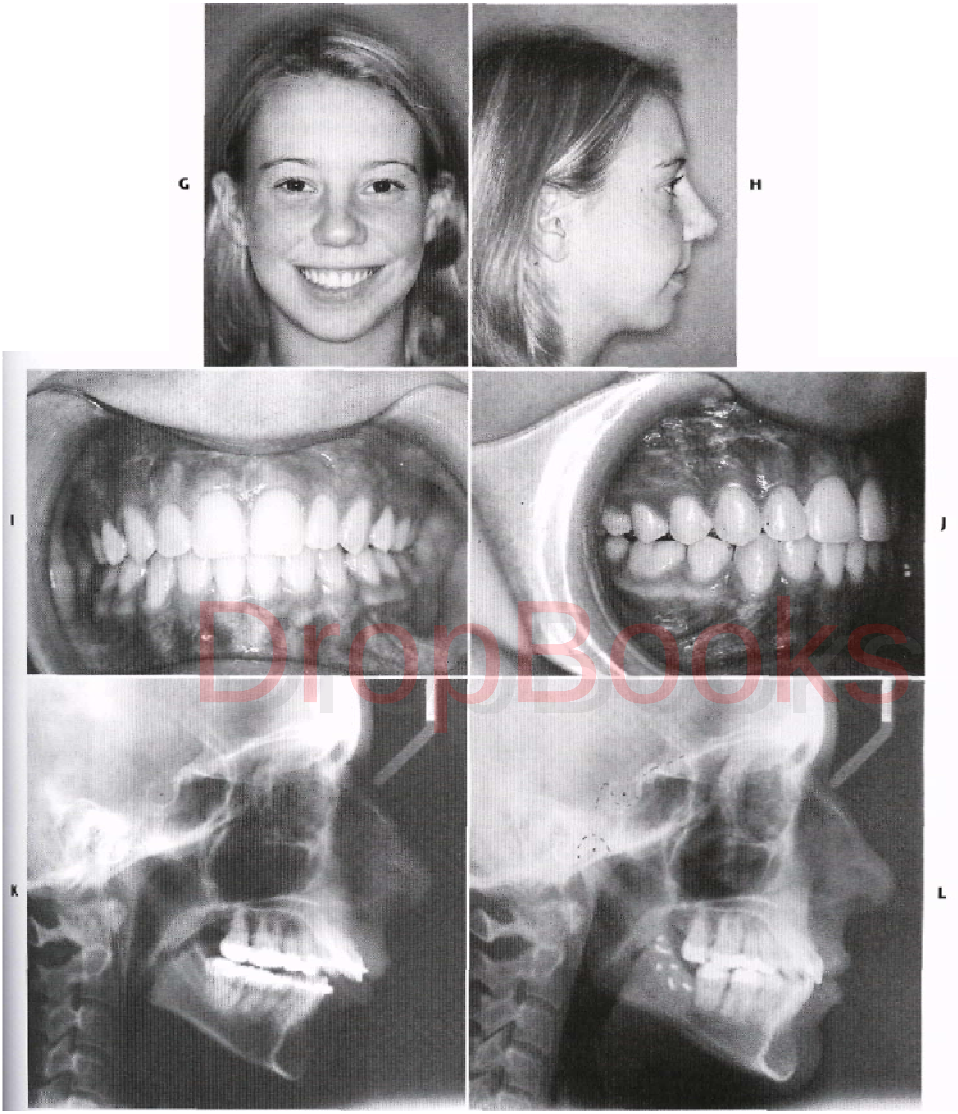

FIG- 25-17—cont'd G and H, Postoperative facial appearance. I and J, Postoperative occlusion. K and L, Preoperative and postoperative radiographs.

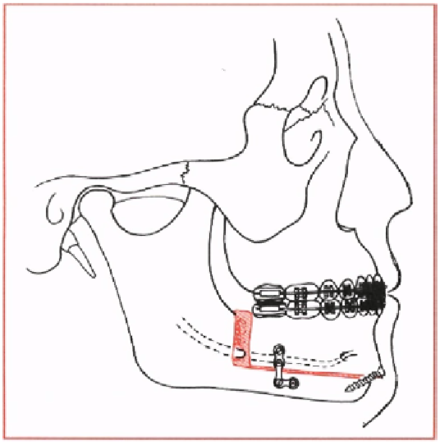

FIG. 25-18 Total subapical osteotomy. Dentoalveolar segment of mandible is moved anteriorly., allowing correction of class II maloc-clusFon without increasing chin prominence.

portion of mandible is osteotomized, moved forward, and stabilized (Fig. 25-19, *A*, C, and *D),* In addition to anterior or posterior repositioning of the chin, vertical reduction or augmentation and correction of asymmetries can also be accomplished with inferior border osteotomies. Alloplastic materials can occasionally be used to augment chin projection; the material is onlaycd in areas of bone deficiencies (Fig. 25-19, *B).*

Maxillary Excess

Excessive growth of the maxilla may occur in the anteroposterior, vertical, or transverse dimensions. Surgical correction of dentofacial deformities with total maxillary surgery (i.e., Le Fort 1) has only become popular since the early 1970s. Before that time maxillary surgery was perfoTmed on a limited basis, and most techniques repositioned only portions of the maxilla with segmental surgery. During the early years of maxillary surgery, many techniques were performed in two stages: Facial or buccal cuts were performed during one operative procedure; then sectioning of palatal bone was performed 3 to 4 weeks later. This staging was done under the assumption that this was necessary to maintain adequate vascular supply to the osteotomized segment. As experience and understanding of these techniques increased, several procedures for anterior and posterior segmental surgery evolved that used single-stage techniques.[1618]

In the early 1950s and 1960s, one of the more popular techniques for correction of maxillary excess was the anterior maxillary osteotomy. Several techniques have been described for repositioning of the anterior maxilla 16,18 Anteroposterior excess of the maxilla in the anterior region can be easily and effectively treated by extracting bicuspid or molar teeth and posteriorly repositioning the anterior portion of the maxilla (Fig. 25-20),

In the early 1970s research by Bell[13] demonstrated that total maxillary surgery could be performed without jeopardizing the vascular supply to the maxilla. This work showed that the normal blood flow in the bony segments from larger feeding vessels could be reversed under certain surgical conditions. If a soft tissue pedicle is maintained in the palate and gingival area of the maxilla, the tramosseous and soft tissue collateral circulation and anastomosing vascular plexi of the gingiva, palate, and sinus can provide adequate vascular supply, which allows mobilization of the total maxilla. Total maxillary osteotomies are currently the most common procedures performed for correction of anteroposterior, transverse, and vertical abnormalities of the maxilla.

Vertical maxillary excess may result in associated facial characteristics, including elongation of the lower third of the face; a narrow nose, particularly in the area of the alar base; excessive incisive and gingival exposure; and lip incompetence (Fig. 25-21 on page 581).

These patients may exhibit class 1, class II, or class ill dental malocclusions. A transverse maxillary deficiency with a posterior cross-bite relationship, constricted palate, and narrow arch form is often seen with this deformity.

Vertical maxillary excess is frequently associated with an anterior open bite relationship (i.e., apertognathia). This results from excessive downward growth of the maxilla causing downward rotation of the mandible *as a* result of premature contact of posterior teeth. To correct this problem the maxilla is repasitioned superiorly, particularly in the posterior area. This allows the mandible to rotate upward and forward, establishing contact in an areas of the dentition. In some cases the occlusal plane of the maxilla is level after orthodontic preparation, and trie open bite can be corrected by repositioning the maxilla in one piece (Fig. 25-22, *A* to *D* on page 582). In other cases a step in the occlusal plane must be leveled to achieve the desired occlusion. This requires repositioning of the maxilla in segments (Fig. 25-22, *E* to *H* on page 583).

Anteroposterior maxillary excess results in a convex facial profile usually associated with incisor protrusion and a class II occlusal relationship. Total maxillary surgery can be completed to correct this problem. In some cases the entire maxilla can be moved in one piece in a posterior direction. In addition to procedures in which the maxilla is moved in one piece, the bone can be sectioned into dentoalveolar segments to allow repositioning in the anteroposterior, superior, or inferior directions or to allow expanding in the transverse direction. Fig. 25-23 on pages 584 and 585, demonstrate* a three-piece maxillary osteotomy performed to correct anteroposterior maxillary excess combined with slight vertical deficiency.

Maxillary and Midface Deficiency

Patients with maxillary deficiency commonly appear to have a retruded upper lip, deficiency of the paranasal and infraorbital rim areas, inadequate tooth exposure during smile, and a prominent chin relative to the middle third of Ihe face. Maxillary deficiency may occur in thcantero-

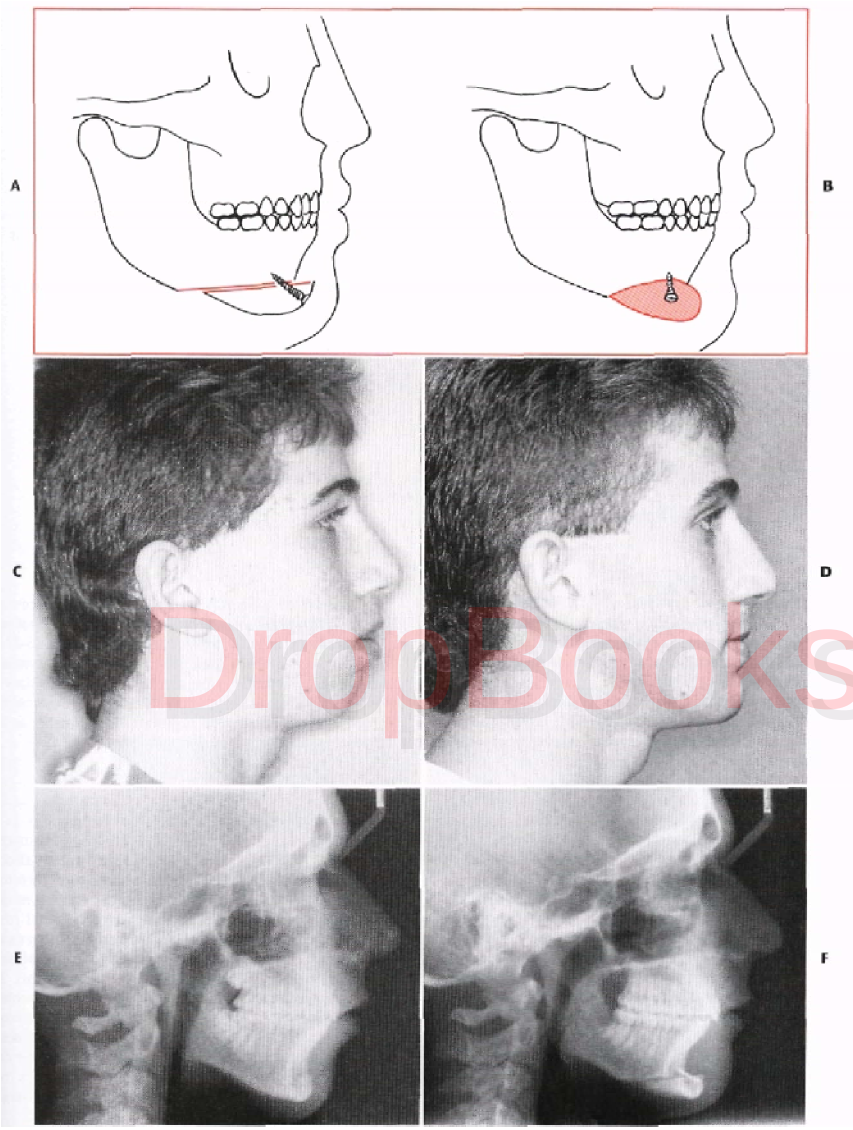

FIG. 25-19 Inferior border modification (i.e., gemoplasty) techniques. A, Advancement of inferior border of mandible to increase chin projection. B, Diagram of implant used to augment anterior portion of chin, eliminating need for osteotomy in this area. C, Clinical picture demonstrating significant chin deficiency. D, Postoperative photograph after advancement of inferior portion of anterior mandible, E, Preoperative radiograph, F, Postoperative radiograph.

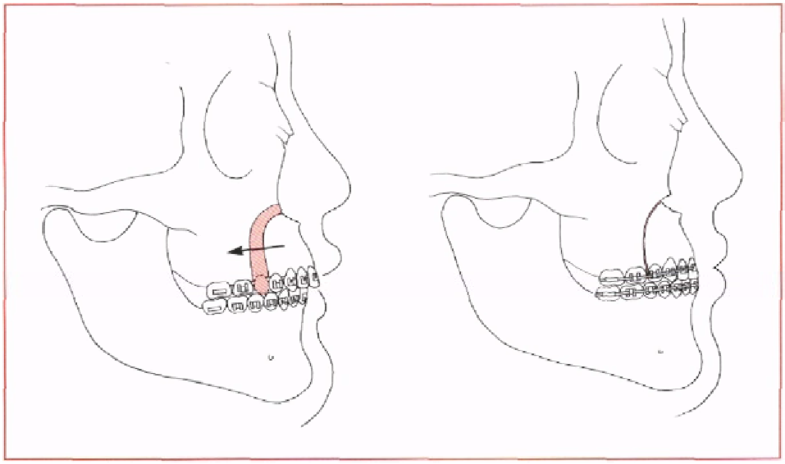

FIG. 25-20 Anterior maxillary osteotomy. A, Removal of premolar teeth and bone in extraction sites. B, Posterior positioning of anterior maxilla closes extraction spaces and corrects excessive anterior overjet relationship,

posterior, vertical, and transverse planes. The patient's clinical appearance depends on the location and severity of the deformity. In addition to the abnormal facial features, a class III malocclusion with reverse anterior overfct is frequently seen.

The primary technique for correction of maxillary deficiency is the Le Port I osteotomy. This technique can be used for advancement of the maxilla to correct a class III malocclusion and associated facial abnormalities (Fig. 25-24 on pages 586 and 587). Depending on the magnitude of advancement, bone grafting may be required to improve bone healing and postoperative stability. In the case of vertical maxillary deficiency, elongation of the lower third of the face can be accomplished by bone grafting the maxilla in an inferior position with the Le Fort I osteotomy technique (Fig. 25-25 on page 588). This technique improves overall facial proportion and normalizes exposure of the incisors during smiling.

In severe rnidface deformities with infraorbital rim and malar eminence deficiency, a Le tort III or modified Lc Fort III type of osteotomy is necessary. These procedures advance the maxilla and the malar uones and, in some cases, the anterior portion of the nasal bones. This type of treatment is commonly required in patients with craniofacial deformities such as Apert's or Crouton's syndrome (Fig. 25-26 on page 589).

Combination Deformities and Asymmetries

Tn many cases the facial deformity involves a combination of abnormalities in both the maxilla and the mandible. In these cases treatment may require a combination of maxillary and mandibular osteotomies to achieve the best possible occlusal, functional, and esthetic result (Figs. 25-27 and 25-28 on pages 590 through 593). Treatment of asymmetry in more than two planes frequently requires maxillary surgery, mandibular surgery, and inferior border osteotomies, as well as recontouring or augmentation of other areas of the maxilla and mandible (Fig. 25-29 on page 594).

DISTRACTION OSTEOGENESIS

One new approach to correction of deficiencies in the mandible and the maxilla involves the use of distraction osteogenesis (DO). When correcting deformities associated with these deficiencies, the conventional osteotomy techniques have several potential limitations (described previously in this chapter). When large skeletal movements are required, the associated soft tissue often cannot adapt to the acute changes and stretching that result from the surgical repositioning of bony segments. This failure of tissue adaptation results in several problems, including surgical relapse, potential excessive loading of the TMJ structures, and increased severity of ncurosensory loss as a result of stretching of nerves. In some cases the amount of movement is so large that the gaps created require bone grafts harvested from secondary surgical sites such as the iliac crest.

DO involves cutting an osteotomy to separate segments of bone and the application of an appliance that will facilitate the gradual and incremental separation of bone segments (Fig. 25-30 on page 595). The gradual ten-

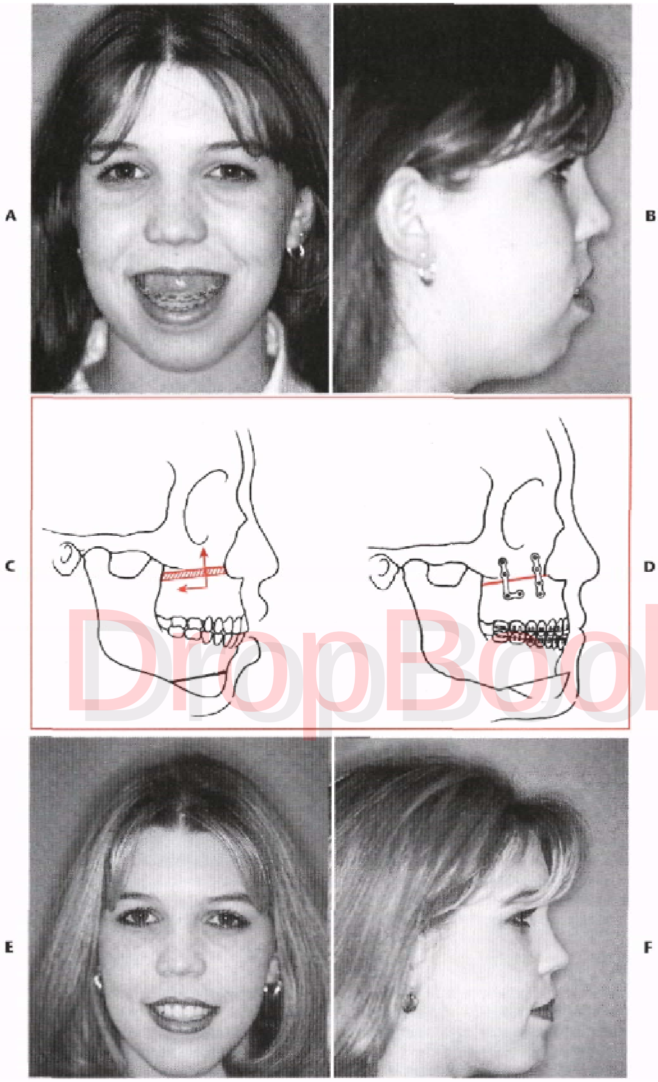

FIG. 25-21 Typical clinical features of vertical maxillary excebi. A tirid E, Full-dn-i.' diul pmlile views demonstrating elongation of lower third of face, lip incompetence, and excessive gingival exposure. C and D, Total maxillary oslеotomy with superior repositioning combined with advancement genioplasty. E and F, Postoperative full-face and profile views after total maxillary osteotomy with superior repositioning and chin advancement. (Text reflated to these images is found on page 578.)

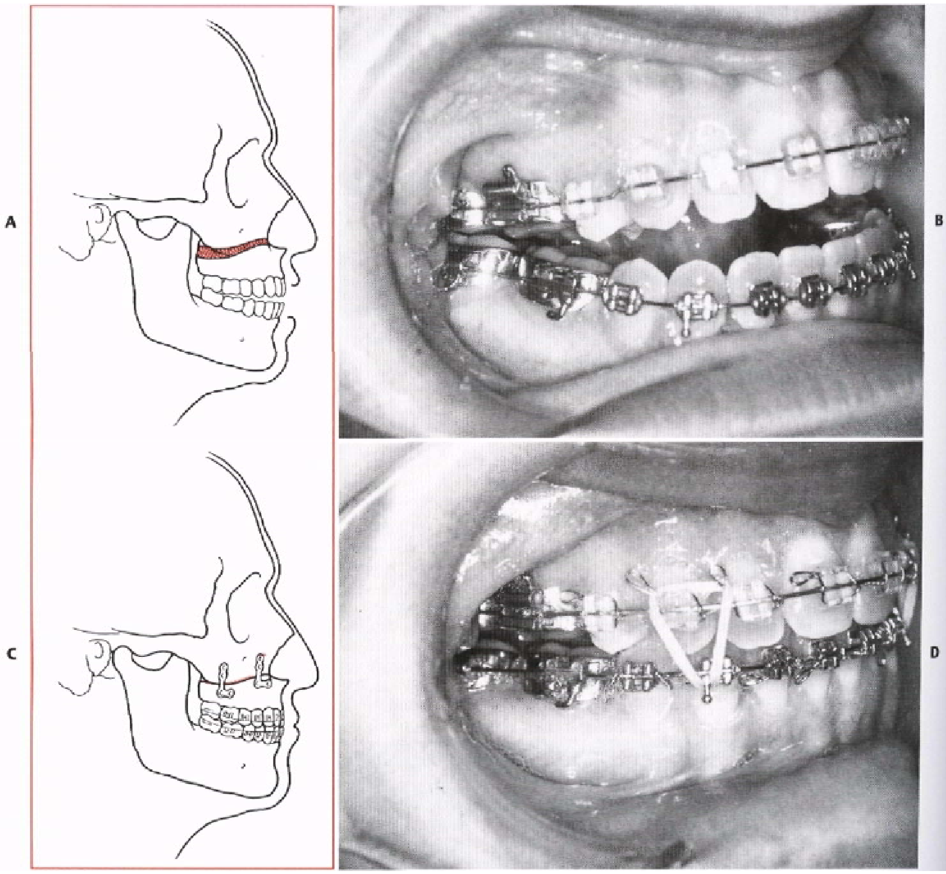

FIG. 25-22 A, Anterior oppn hitt .1 1 l* nil nl ^rtkvjl rn.1x1ll.17 e«cess with entire maxillary occlus<il plane 011 one level, B, Presjryir^l m 1IUSIUM C, ^urgiral correction with superior repositioning uf maxilla in ore piece. D, Postoperative occlusion. (Text related to these images is found an page 578.)

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sion placed on the distracting bony interface produces continuous bone formation. Additionally, the surrounding tissue appears to adapt to this gradual tension, producing adaptive changes in all surrounding tissues, including muscles and tendons, nerves, cartilage, blood vessels, and skin. Because the adaptation involves a variety of tissue types in addition to bone$_f$ this concept should also include the term *distraction histogenesis.*

rhe concept of distraction is nol new. Use of traction techniques to help bones heal to a correct length can be traced back to the time of Hippocrates when an external device was used to apply traction to *a* fractured and shortened leg.[20] A Russian surgeon, Gavrill llizaarov, developed the current concept of correcting bony deficiencies in the 1950s. The result of his work was not widely disseminated to the rest of the world until the

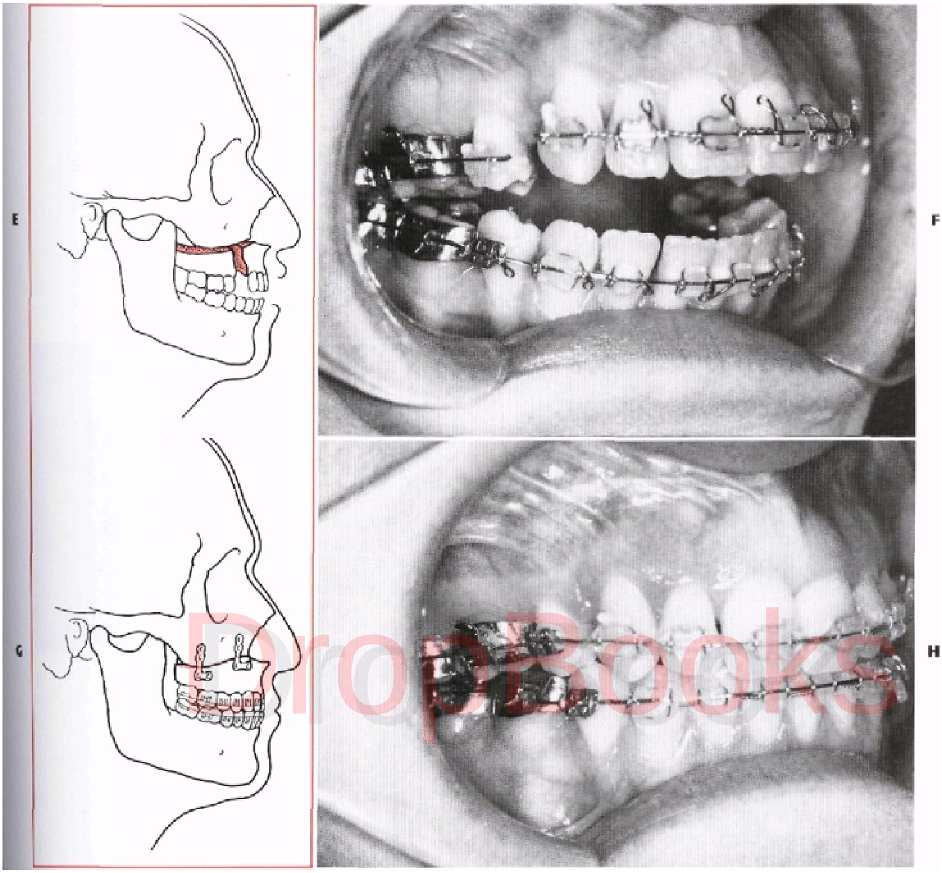

FIG. *25-22*—COnt'd E, Open bite with maxillary oeclusal plane on two levels. F, Presurgical occlusion. G, Segments maxillary repositioning to close open bite and place segments on same plane ol occlusion, H, Postoperative occlusion. (Text related to these images is found on page 578.)

I late 1970s and early 1980s.[21'22] Since that time the application of these principles has extended to all forms of orthopedic correction, including craniofadal surgery.[23,24]

DO involves several phases, including the osteotomy or surgical phase, latency period, distraction phase, consolidation phase, appliance removal and remodeling. During the surgical phase an osteotomy Is completed and the distraction appliance is secured, The latency phase is the period when very early stages of hone healing begin to take place at the osteotomy bony interface. The latency phase is generally 7 days during which time the appliance is not activated. After the latency period the distraction phase begins at a rate of 1 mm per day. This distraction rate is usually applied by opening or activating the appliance 0.5 mm twice each day. The amount of activa-

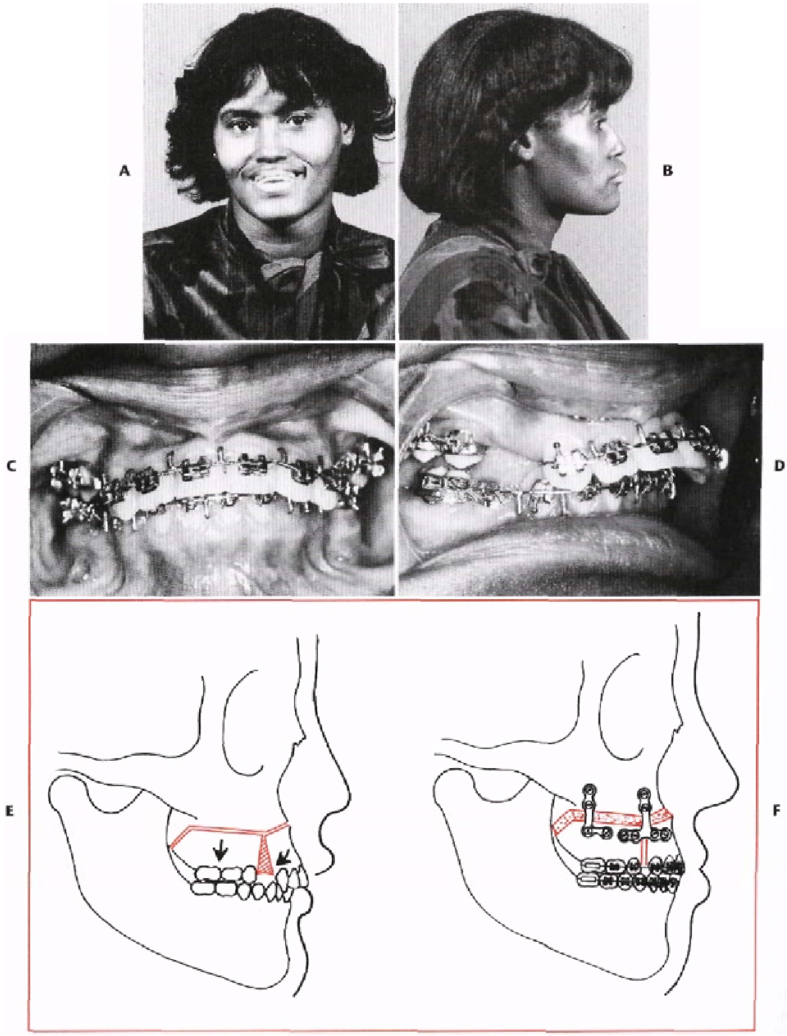

FIG. 25-23 Case report of segments? maxillary osteotomy. A and B, Preoperative facial appearance demonstrates extreme protrusion of anterior maxillary segment and upper lip, decreased nasolabial angle, and decreased lower face height as a result of maxillary vertical deficiency. C and D, Preoperative occlusion demonstrates protrusive maxillary incisors and extraction space remaining after removal of maxillary bicuspid tooth bilaterally. E and F, Segmental maxillary osteotomy with closure of bicuspid extraction space, retraction of anterior segment of maxilla, and placement of bone graft in posterior maxillary area. (Text related to these images is found on page 578.)

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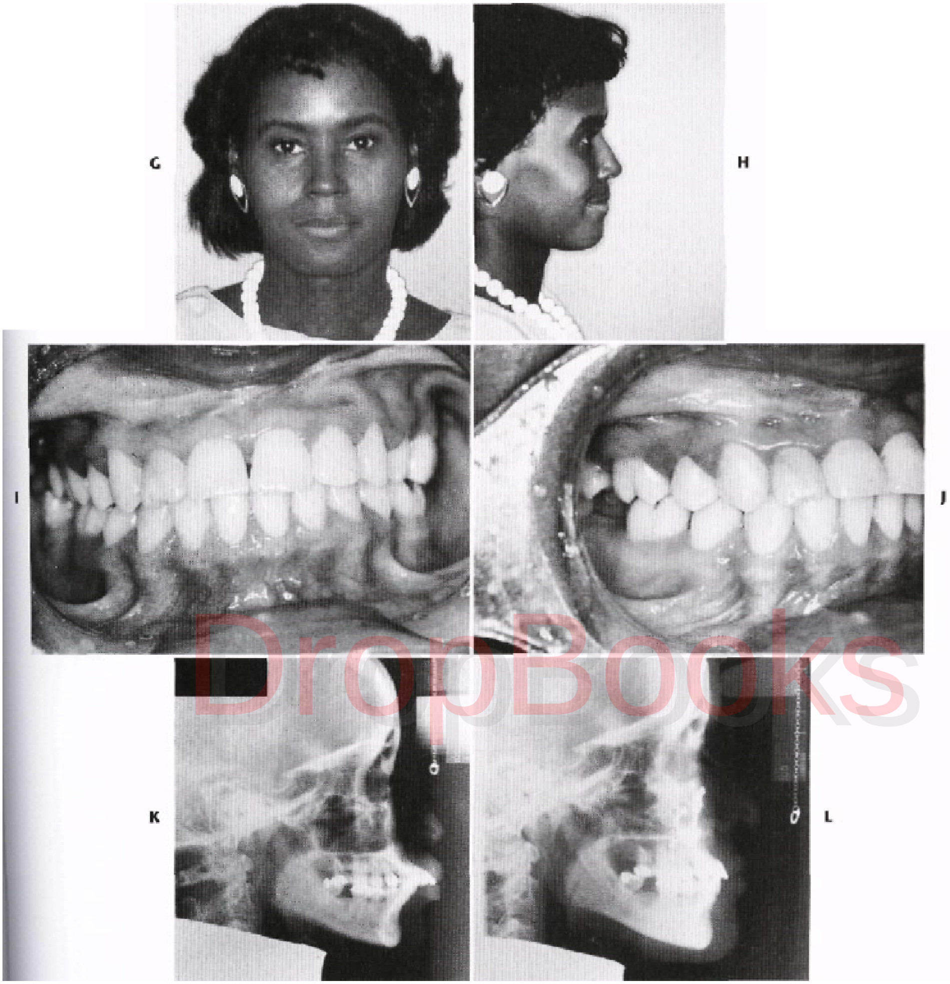

FIG- 25-23 —conl'd C and H, Postoperative facial appearance. I and J, Postoperative occlusion. K and L, Preop era Live and postoperative radiographs, (Text related to these images is found on page 578.)

lion per day is termed the *rate of distraction;* the timing of appliance activation each day is termed the *rhythm.* During the distraction phase the new immature bone that forms is called the *regenerate.* Once the appropriate amount of distraction has been achieved, the appliance remains in place during the consolidation phase, allowing for mineralization of the regenerate bone. The appliance is then removed, and the period of time from tht application of normal functional loads to the complete maluration of the bone is termed *the remodeling period*

A B C D E F

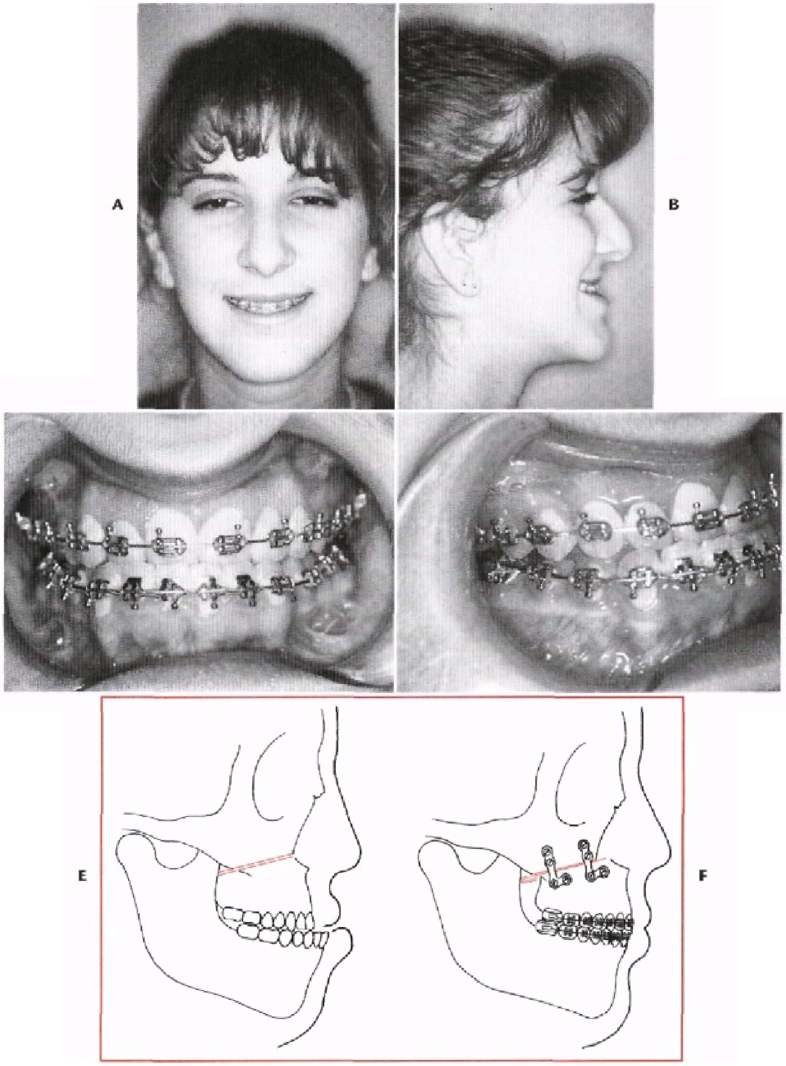

FIG. 25-24 Case report of Le Fort I advancement. A and B, Preoperative facial esthetics demonstrating maxillary deficiency evident by slight facial concavity and para nasal deficiency. C and D, Preoperative occlusion demonstrating class III relatiori5hip. E and F, Le Fort I osteotomy for maxillary advancement. (Text related to these images is found on page 580.)

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G H I J K L

FIG. 25-24 ■ cont'd G and H, Postoperative facial appearance. (This patient also underwent a simultaneous rhinoplasty procedure.) I and |, Postoperative occlusion, K and L, Preoperative and post-operative radiographs. (Text related to these images is found on page 5&0.)

Uecausc the use of these techniques in orthognathie surgery is relatively new, very few long-term studies are available that document all of the potential benefits of DO. Possible advantages include the ability to produce larger skeletal movements; eliminate the need for bone grafts and the associated secondary surgical site, better long-term stability, less trauma to the TMjs, and decreased neurosensory loss. DO also has certain disadvantages: The placement and positioning of the appliance to produce the desired vector of bone movement is very technique sensitive and sometimes results in tess-than-ideal occlusal positioning, resulting in discrepancies such as small open

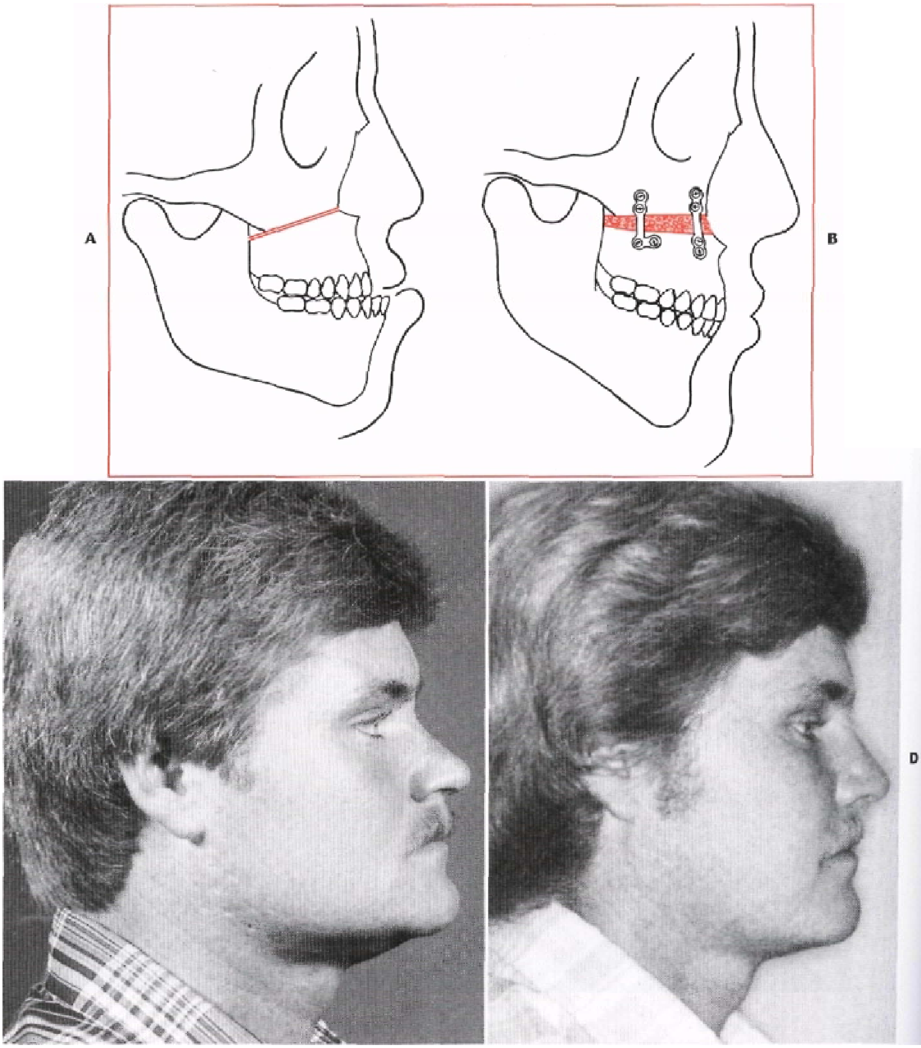
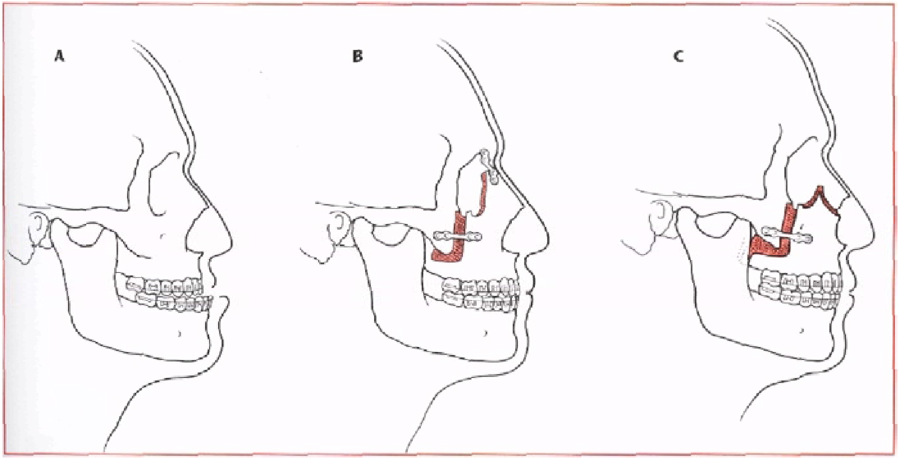


FIG. 25-25 A and B, inferior repositioning of maxilla and interpositions! bane grafting. C, Preoperative profile view demonstraling vertical deficiency of lower third of face and resulting appearance of relative mandibular excess. D, Postoperative view after inferior repositioning of maxilla. Note normal facial vertical and dnteroposterior relationships. (Text related to these images is found on page 530.)



FIG, 25-26 A, Severe midface deficiency. B, Le Fqrt III advancement, C, Modified Le forl III advancement. (Text related to these images is found on page 580.)

bites or asymmetries. Other disadvantages include the need for two procedures: (1) placement and (2) removal of the detractors, as well as increased cost and longer treatment time, with more frequent appointments with both the surgeon and the orthodontist.

One of the earliest uses of the DO concept in orthognathic surgery involved widening of the maxilla with a technique termed *surgical-assisted rapid palatal expansion.*^ An adult maxilla with significant transverse deficiency is nearly impossible to correct with conventional orthodontic treatment. Even correction with segmcntal maxillary suTgery to produce expansion has often shown disappointing results.[26] The use of surgical assisted palatal expansion, incorporating the concepts of DO, seems to produce better long-term results in these cases.[27] In these cases the expansion device is secured in place by the orthodontist. A surgical procedure is then completed by performing the bony cuts as described for a Le Fort I osteotomy, with the exception that the most posterior attachment of the lateral nasal wall and perpendicular plate of the palatine bone are riot divided. A midline cut is also completed to create separation between the central incisors extending along the midpalatal suture. After a latency period, the expansion device is activated 1 mm per day until the desired expansion takes place (Fig. 25-31 on page 596). During this time a space develops between the central incisors, along the midpalatal suture and at the area of the osteotomy along the lateral maxillary wall.

Bony regenerate gradually fills and matures in these areas, The appliance is then removed and active orthodontic treatment is begun to close space between teeth arid properly align the arch and maintain the expansion.

In the case of mandibular deficiency, the initial surgical procedure involves performing an osteotomy and placement of the distraction appliance. After a latency period of 7 days, the distraction occurs with a rate and rhythm of 1 mm per day (completed by activating the appliance 0.5 mm twice each day). Once this distraction is complete the appliance is left is place for the consolidation phase, which is usually two or three times the amount of time required for the distraction phase. The appliance is then removed, and active orthodontic treatment continues. Fig. 25-32 on pages 597 through 599 demonstrates a case of DO of the mandible.

Distraction appliances are also available for maxillary advancement (i.e., DO) to correct severe anteroposterior deficiencies of the maxilla.

PERIOPERATIVE CARE OF THE ORTHOGNATHIC SURGICAL PATIENT

Patients undergoing orthognathic surgery are usually admitted to the hospital on the day of surgery. Before surgery the medical history, complete physical examination, preoperative laboratory tests, radiographic examinations, and consultation with the anesthesiologist are completed. Orthognathic surgery is accomplished in the operating room with the patient under general anesthesia. After surgery the patient is taken to the postanesthesia care unit (i.e., recovery room) for an appropriate period, usually until alert, oriented, comfortable, and exhibiting stable vital signs; then the patient is returned to the hospital room. The nursing staff trained and experienced in the postoperative care of surgery patients continually

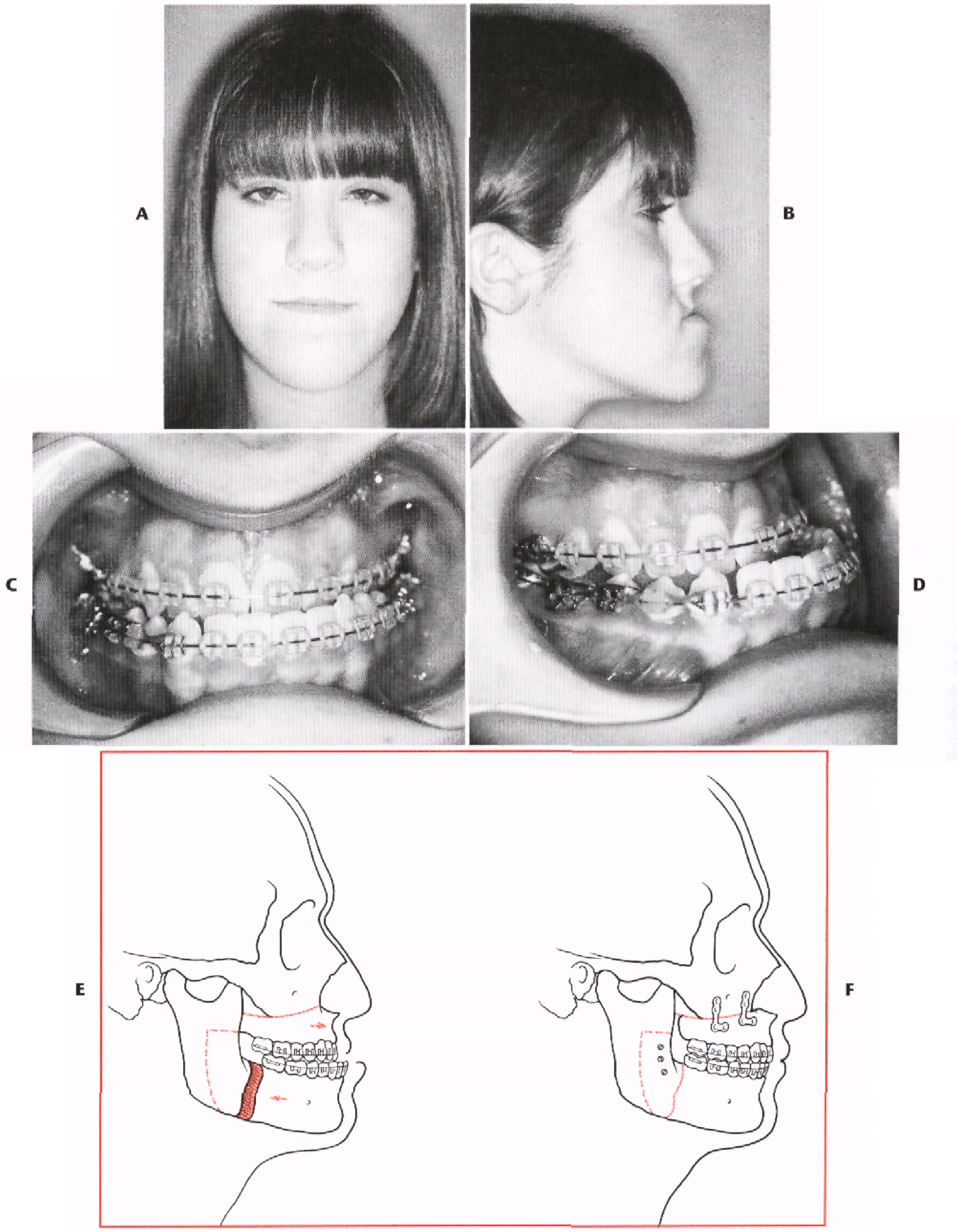


FIG. 25-27 Case report of maxillary advancement and mandibular setback. A and B, Preoperative facial esthetics demonstrating severe maxillary deliciency combined with mandibular excess. C and D, Preoperative occlusion demonstrating class III relationship. E and F, Le Fort I osteotomy for maxillary advancement and bilateral sagittal **osteotomies** lor setback ol the mandible. **(Text** related to these images is found on page 5B0.)

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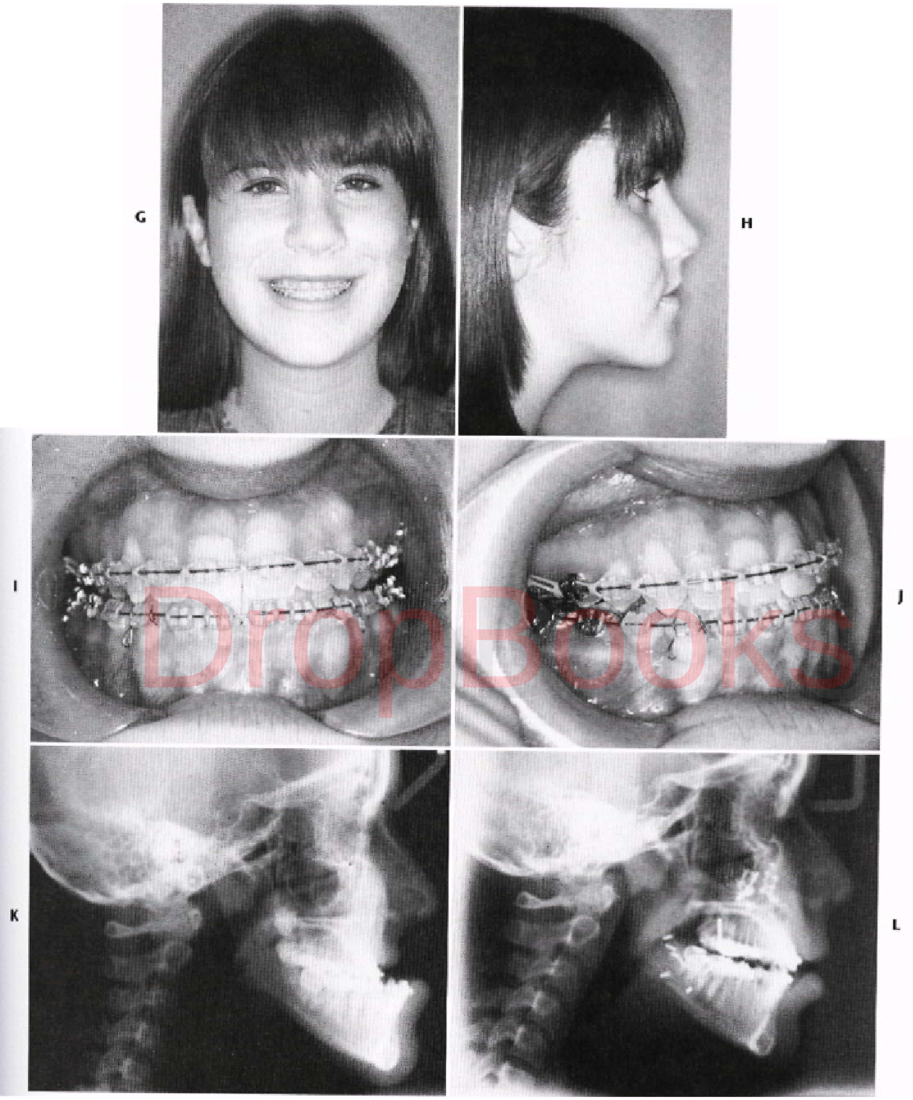

FIG 25-27—conl'd C and H, Postoperative facial appearance. I and j, Postoperative occlusion. K and L, Preoperative and postoperative radiographs. (Text related to Lhese images is found on page 580.)

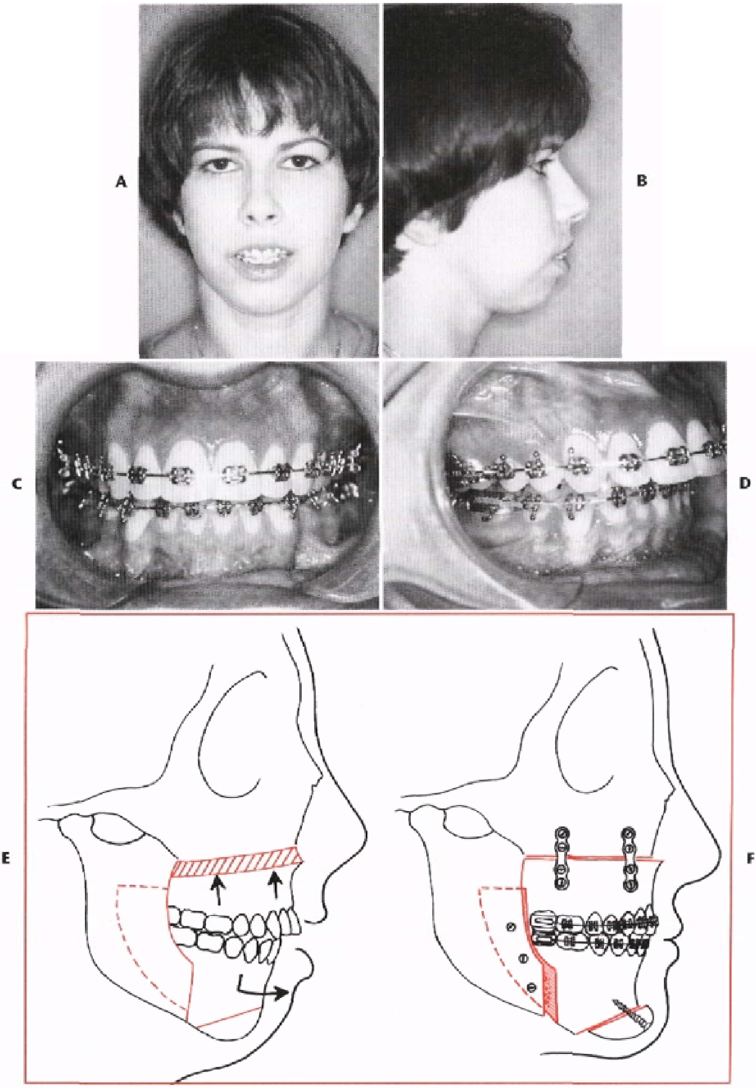

FIG. 25-28 Case report Of superior maxillary repositioning, mandibular advancement, and genioplasty. A and B, Preoperative facial esthetics demonstrating typical appearance of vertical maxillary excess and mandibjlar deficiency, including excess incisor exposure, lip incompetence, and Sack of chin projection. C and D, Preoperatiwe occlusion demonstrating class II malocclusion. E and F, Diagram of Le Fort I osteotomy with superior repositioning of maxilla, sagittal osteotomies of mandible for advancement, and advancement genioplasty. (Text related to these images is found on page 5S0.)

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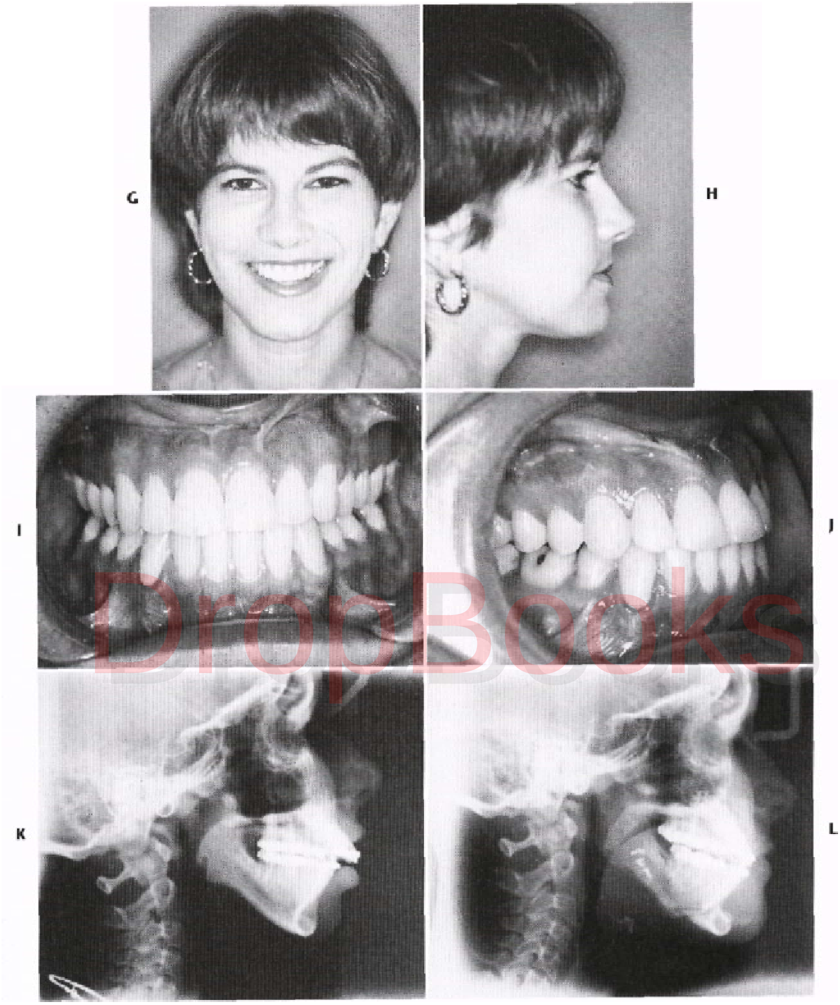


FIG. 25-28—cont'd G and **H,** Postoperative facial appearance. I and 1, Postoperative occlusion. K and L, Preoperative and postoperative radiographs.(Text related to these image? is found on page 580.)

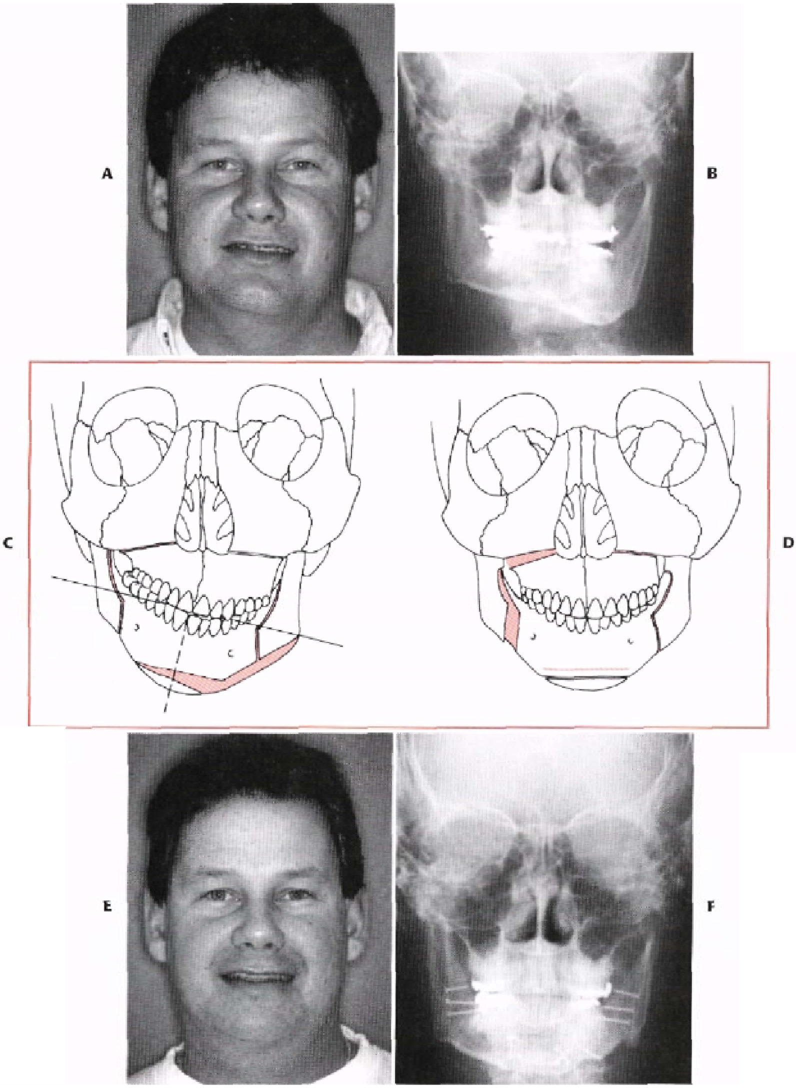
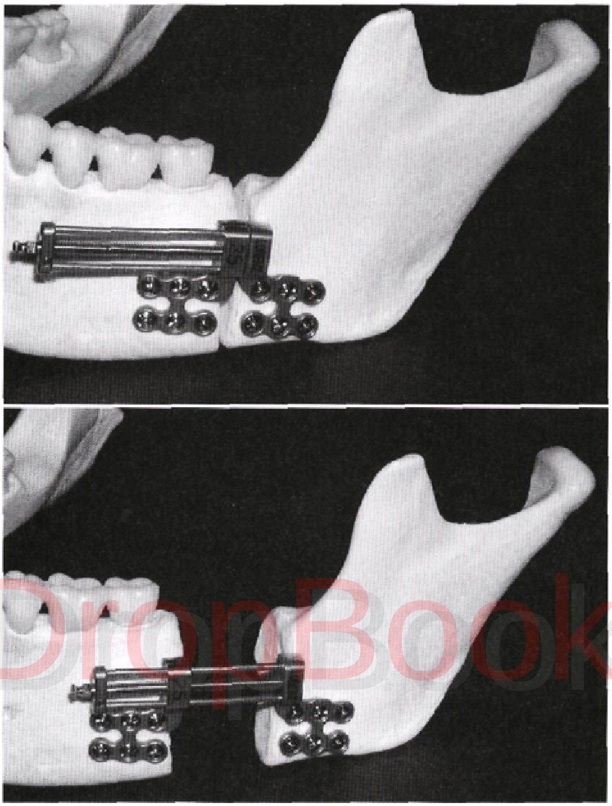


FIG. 25-29 Factor asymmetry requiring maxillary and mandibular osteotomies, gcnioplasty, and inferior border recontouring tor correction. A, Preoperative facial esthetics- 8, Preoperative radiograph. C and D, Diagrams of Le Fort I osteotomy with inferior repositioning on right side and superior repositioning on left, sagittal osteotomies of mandible with advancement on right sfde and superior repositioning on left, asymmetric genioplasty, and left inferior border recontouring. E, Postoperative facial appearance F, Postoperative radiograph. (Text related to these images is found on page 580.)



A

B

FIG. 25-30 DistrdcLor appliance used tor mandibular advancement. A, Osteotomy of posterior mandibulsr body and ramusarea with distractor in place. B, View showing distraction appliance fully expanded. Regenerate bone fills the intrabony gap during slow incremental activation of detractor. (Text related to these images begins on page 580.)

monitors postoperative progress. the patient is discharged when feeling comfortable, taking food and fluid orally without difficulty, and ambulating well. The postsurgical hospital stay usually ranges from 1 to 4 days, Patients generally require only milcl-to-mo derate pain medication during this time and often require no analgesics after discharge. As soon as is feasible, postoperative radiographs are obtained to ensure that the predicted bone changes have taken place.

The importance of postoperative nutrition should be discussed with patients and their families before the hospital admission for surgery. During the postoperative hospital stay, a member of the dietary staff may instruct the patient in methods of obtaining adequate nutrition during the period of IMF or limited jaw function. Special cookbooks designed for patients undergoing jaw surgery contain instructions for the preparation of diets in a blender.

In the past, one of the major considerations in the immediate postoperative period was the difficulty resulting from IMF. When the jaws are wired together, the patient has initial difficulties in obtaining adequate nutrition, performing necessary oral hygiene, and communicating verbally. The average JVIF period ranges from 6 to 8 weeks.

During the past few years, several systems using small bone screws and bone plates have been developed to provide direct bony stabilization in the area of the osteotomies (Fig, 25-33 on page 600).[Z8<29] The most recent development in rigid internal fixation is the use of screws **and** plates made of resorbalMe material (see Fig. 25-33, *Q,* The

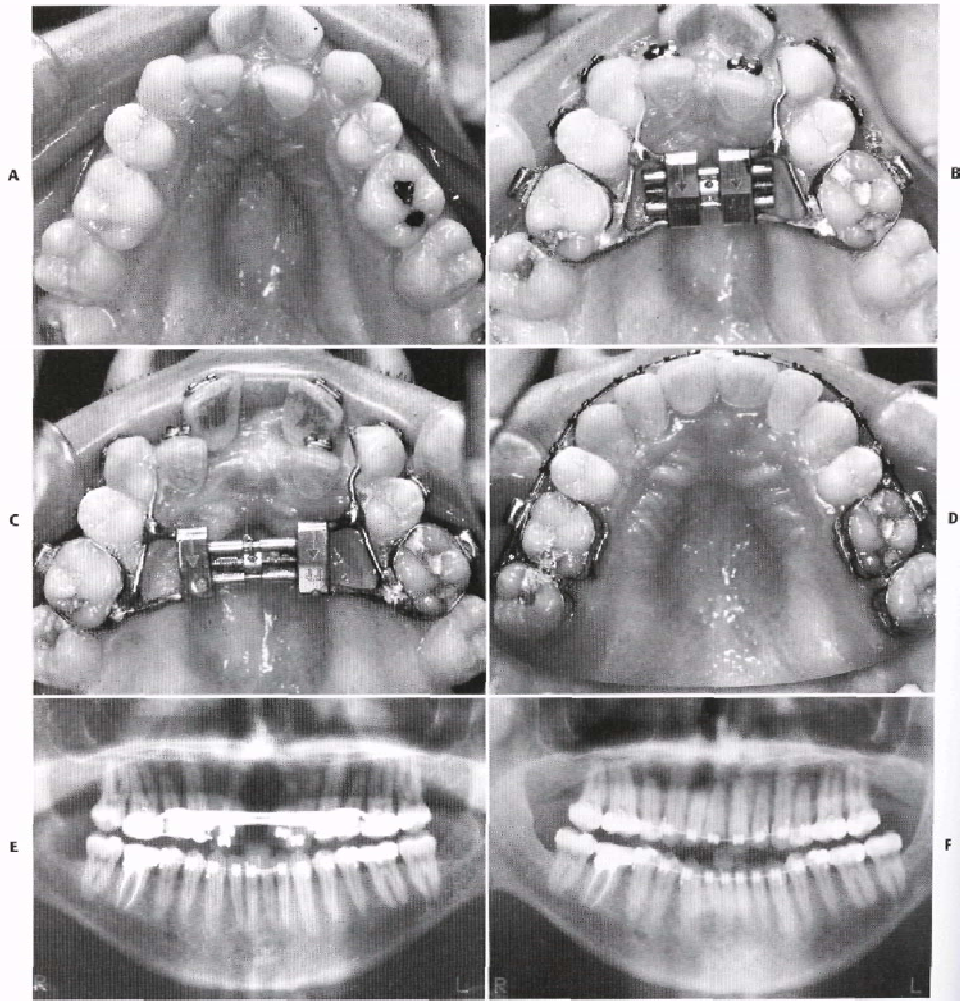


FIG. 25-31 Distraction usteogeoesis with surgically assisted palatal expansion for correction of transverse maxillary deficiency. A, Severe constriction of maxilla with inadequate arch length (note that severe crowding exists even though premolars have been extracted). B, Expansion device in place, C_T Maxilla expanded (note space between central incisors). Both osteogenesis, with bone formation, and histogenesis, with formation of gingival tissue, are occurring. D, Space closed with anterior teeth orthodontically aligned using newly formed regenerate bore. E, Radiograph showing expansion with immature regenerate in anterior space, F, Radiograph after orthodontic alignment. (Text related ro these images is found on page *589.)*

FIG. 25-32 Case report of distraction osteogenesis (DO) to correct severe mandibular deficiency. A and B, Preoperative facial esthetics demonstrating severe mandibular deficiency. C and D, Preoperative occlusion demonstrating class II relationship. (Text related to these images is found on page 589.)

Continued

materials arc capable of maintaining adequate strength lo stabilize bone during the healing period and arc then resorbed by hydrolization. The use of these rigid fixation systems allows for early release from or total elimination of IMF, which results in improved patient comforl, convenience of speech and oral hygiene, and improved postsurgical jaw stability and function.

At the lime of surgery a small acrylic occlusal wafer is used to help position and stabilize the occlusion. When the IMF is released (usually in the operating room), the splint is wired to either the upper or lower jaw. Light elastics are then placed on the surgical wires, and the combination of the splint and elastics serves to guide the jaw inlo the new postsurgieal occlusion (Fig. 25-34 on

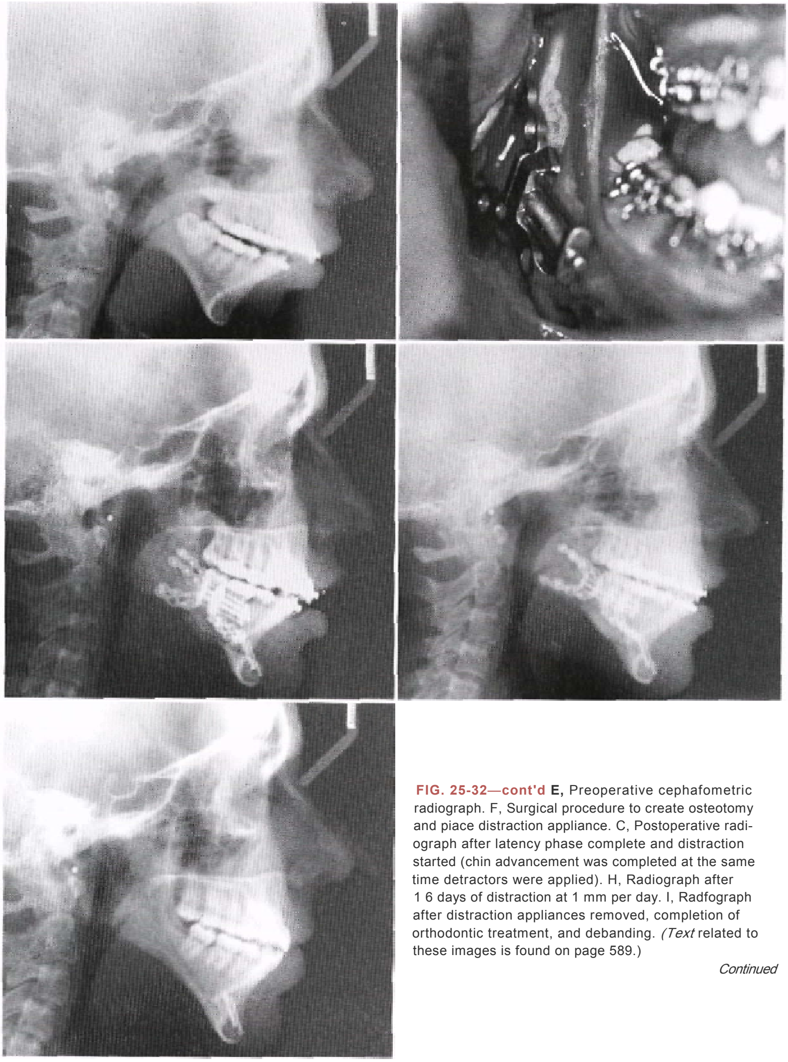


FIG. 25-32—cont'd E, Preoperative cephafometric radiograph. F, Surgical procedure to create osteotomy and piace distraction appliance. C, Postoperative radiograph after latency phase complete and distraction started (chin advancement was completed at the same time detractors were applied). H, Radiograph after 1 6 days of distraction at 1 mm per day. I, Radfograph after distraction appliances removed, completion of orthodontic treatment, and debanding. *(Text* related to these images is found on page 589.)

Continued

J K

L M

FIG.25-32----cont'd j and K, Postoperative facial appearance. L and M, Postoperative occluwl views. tjoxi related to these images is found on page 589.)

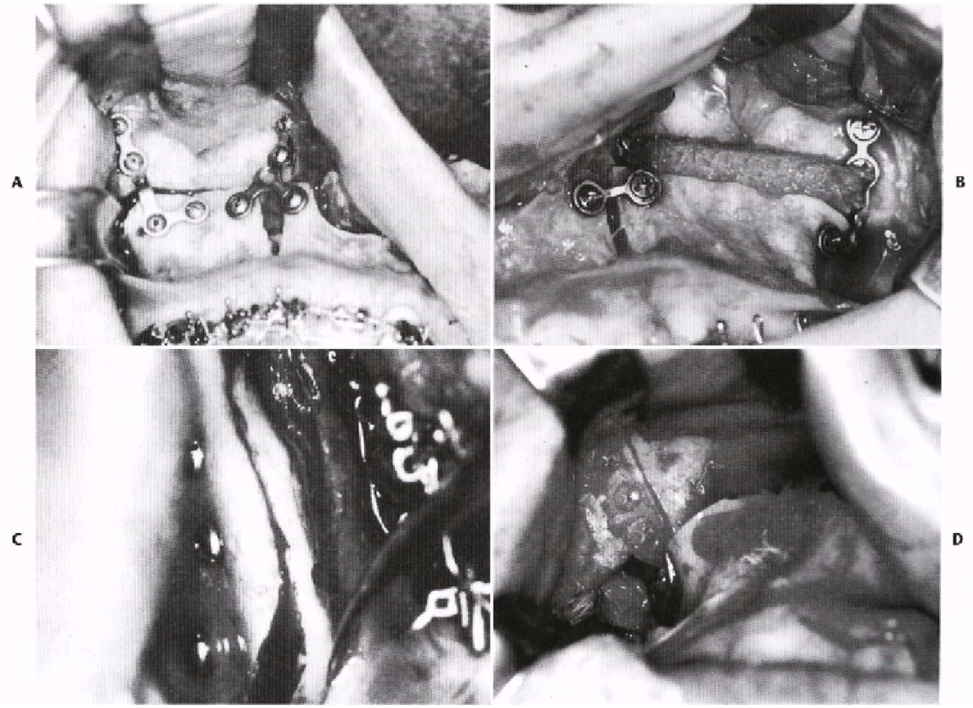


FIG. 25-33 A, Use of small bone plates for stabilization of maxillary osteotomy. B, Maxillary advancement and down graft with iliac crest bone graft stabilized with bone plates. C, Lag screws used to secure mandibular sagittal split osteotomy. D, Resorbable bone plates used to stabilize maxillary osteotomy (Text related to these Images begins on page 595.)

page 601). After an adequate accommodation period, the occlusal splint is removed and the patient returned to the orthodontist's care,

POSTSURGICAL TREATMENT PHASE

Completion of Orthodontics

When satisfactory range of jaw motion and stability of the osteotomy sites are achieved, the orthodontic treatment can be finished. The heavy surgical arch wires are removed and replaced with light orthodontic wire, Final alignment and positioning of the teeth is accomplished, as is closure of any residual extraction space. The light vertical elastics are left in place at this time to override proprioceptive impulses from the teeth, which otherwise would cause the patient to seek a new position of maximal intercuspation. The settling process proceeds rapidly and rarely takes longer than 6 to 10 months.

Retention after surgical orthodontics is no different from that for other adult patients, and definitive periodontal and prosthetic treatment can be initiated immediately after the final occlusal relationships have been established.

Postsurgical Restorative and Prosthetic Considerations

When patients require complex final Testorarive treatment, it is important to establish stable, full-arch contact as soon after orthodontic debanding as possible. Posterior vertical contacts are important in patients who have only anterior components of occlusion remaining. Well fitting, temporary, removable partial dentures may suffice, and these appliances should be relined with tissue-conditioning materials as needed to maintain the posterior support during healing. When postsurgical orthodontics is complete, the remainder of restorative treatment can be accomplished in the same manner as for any nonsurgical patient.

A

B

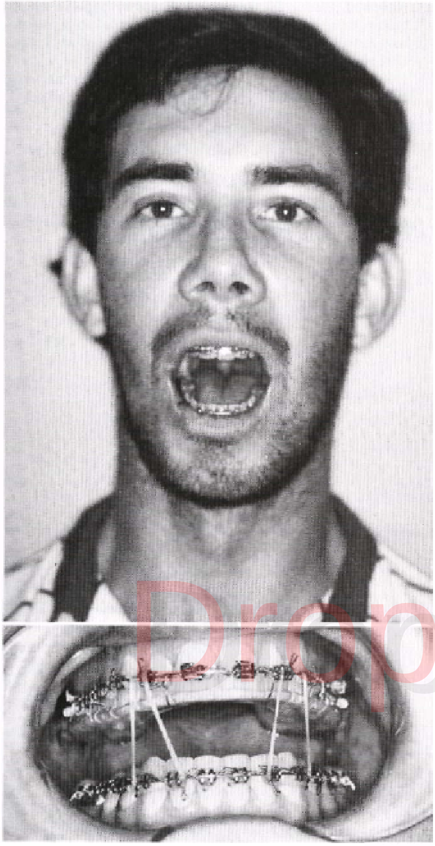


FIG. 25-34 A, Interocclusal splint wired to maxilla. **Light elastics** are used to help guide patient into new postoperative occlusion, B, Patient *7* days after maxillary and manclibular osteotomies. Note excellent early function. (Text related to these images begins on page 597.)

Postsurgical Dental and Periodontal Considerations

The patient should be seen for a maintenance dental and periodontal evaluation approximately 10 to 14 weeks po imperatively. The mucogingival status is reevaluated, the mouth deplaqued, and areas of inflammation or pocketing lightly instrumented. Frequent recall maintenance should continue during the remainder of orthodontic care when necessary. After the orthodontic appliances are removed, a thorough prophylaxis with a review of oral hygiene techniques is advisable. A thorough periodontal reevaluation 3 to 6 months after completion of the posf surgical orthodontics will determine future treatment needs. Periodontal surgery, including crown-lengthening or regenerative procedures, should be performed after the inflammation associated with orthodontic appliances has resolved, Areas of hyperplastic tissue should be observed for 3 to 6 months after orthodontic therapy, unless esthetic or restorative considerations necessitate earlier tissue removal. After completion of periodonta] treatment, recall intervals should be adjusted to accommodate the individual patient's needs.

SUMMARY

The treatment of patients with dentofacial deformity involves the evaluation and treatment of many types of dental and skeletal problems. These problems require that all practitioners involved in patient care interact in a multidisciplinary team approach to treatment. This sequential, team approach yields the most satisfying results,

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